

A Revision of the Recent Solariellinae (Gastropoda: Trochoidea) of the New Zealand Region

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ABSTRACT

Twenty-nine species (17 new) of Solariellinae are recorded from the Norfolk Ridge, Three Kings Rise, Kermadec Ridge, and New Zealand. The species are referred to *Solariella* Wood, 1842 (10 species, 4 of which are new), *Bathymophila* Dall, 1881 (3 new), *Microgaza* Dall, 1881 (1 new), *Archimiuolia* Iredale, 1929 (10, 6 new), and *Zetela* Finlay, 1926 (5, 3 new). *Zeminolia* Finlay, 1926, is treated as a synonym of *Solariella*. *Bathymophila* Dall, 1881, is transferred from Margaritinae to Solariellinae on the basis of radular morphology. *Ethaliopsis* Schepman, 1908, is synonymized with *Bathymophila*, the shell of a paralectotype of *Solariella* (*Ethaliopsis*) *callomphala* Schepman, 1908, is illustrated, and a lectotype is designated for the species. *Lamellitrochus* Quinn, 1991, (based on a western Atlantic species) is regarded as a probable synonym of *Zetela*, and the southern African species *Solariella intermissa* Thiele, 1925, and the North Atlantic species *Trochus* (*Margarita*) *rhina* Watson, 1886 (= *Solariella cincta* sensu Dautzenberg and Fischer, 1896, and Dautzenberg, 1927, not Philippi, 1836) are referred to *Zetela*. Sexually dimorphic shell morphology in New Zealand *Solariella* species is discussed.

Key words: Trochidae, Solariellinae, new taxa, New Zealand, Kermadec Ridge, Norfolk Ridge, North Atlantic, western Atlantic, southern Africa.

INTRODUCTION

The trochid subfamily Solariellinae has a cosmopolitan distribution from sublittoral to abyssal depths. Solariellines are deposit feeders, and most if not all of them are proficient sediment sifters. Species examined alive are capable of withdrawing and rapidly moving the foot from side to side, exhibiting a typical response (Herbert, 1987). Although several species have consistently collected alive from rugged substrata associated with bryozoans, sponges, hydroids, and other invertebrates, it is likely that they live and feed in the surrounding water column rather than in association with other organisms. Most of the New Zealand species have exceptional longevity and adaptations for sediment dwellers, suggesting that they have specific biological requirements. The sex-

es are separate and some species brood within the pallial cavity or the umbilicus. Whereas shell morphology is frequently little different from that in Margaritinae and Umboniinae and is interspecifically variable, the animal is distinctive in having tentaculiform processes on the snout and a short, broad radula with a low number of rows (ca. 20) of teeth; few, simple marginal teeth (6–10 pairs); and distinctive central and lateral tooth morphology. The central and inner three pairs of laterals are short and stout with angulate cutting areas (lateral 3 may have a reduced cutting area), and lateral 4 is elongate, curved, and typically lacks secondary cusps. Many species are further characterized by having the innermost pair of marginal teeth transformed during ontogenesis into broad lateromarginal plates.

Abbreviations and text conventions:

- AIM Auckland Institute and Museum
AMS Australian Museum, Sydney
cf. compare (with)
BMNH The Natural History Museum, London
NMNZ Museum of New Zealand Te Papa Tongarewa, Wellington
NZOI National Institute of Water and Atmospheric Research, Wellington
TW (number of) teleoconch whorls
USNM National Museum of Natural History, Washington, D.C.
ZMA Zoological Museum, Amsterdam

In all measurements of shells, length precedes width. Unless specified, all material was collected as dead shells and is deposited at NMNZ.

SYSTEMATICS

Superfamily Trochoidea Rafinesque, 1815

Family Trochidae Rafinesque, 1815

Subfamily Solariellinae Powell, 1951

Solariellinae Powell, 1951: 102—nominotypical genus

Solariella Wood, 1842.

Talopidae Finlay, 1928: 238—nominotypical genus *Talopia*
Gray, 1842 (in part).

Minoliinae Kuroda, Habe, and Oyama, 1971: 26—

nominotypical genus *Minolia* A. Adams, 1860.

Remarks: Interpretation of groups of solarielline genera has been complicated by the fact that the type species of *Solariella* (*S. maculata* Wood, 1842) is a Pliocene fossil and because some Recent species that resemble it have adult radulae with lateromarginal plates, whereas other species lack them. One Recent species that bears a particularly close resemblance to *S. maculata* (Herbert, 1997, fig. 204–206) is *S. cincta* (Philippi, 1836) (Warén, 1993, fig. 2E, as *S. inoptanda* Locard, 1897 = *S. cincta*), the adult radula of which lacks lateromarginal plates (F. Rubio, pers. comm.). Another similar European species is *Solariella amabilis* (Jeffreys, 1865) (figure 40), the adult radula of which has broad lateromarginal plates (Warén, 1993, fig. 7B). *Solariella amabilis* (= *Trochus affinis* Friele, 1877) is the type species of *Machaeroplax*, which has generally been interpreted as a synonym of *Solariella* (Odhner, 1912; Thiele, 1929; Marshall, 1979; Quinn, 1979; Hickman and McLean, 1990; Warén, 1993; herein), although Herbert (1987) was more cautious in his approach.

Warén (1990) has shown that solarielline lateromarginal plates appear during radular ontogenesis. He was unable to ascertain their origin, but it seems likely that they arise by progressive in-column transformation of existing teeth such as the innermost pair of marginals rather than by intercalation (which among Trochoidea is known to occur only in calliostomatids). Whatever their origin, presence or absence in adults of lateromarginal plates, or degree of transformation of the teeth from which they apparently develop, cannot be used alone for separation of genera or subgenera, since radular ontogenesis will naturally be accelerated or retarded to varying degrees from species to species. Whereas lateromarginal plate morphology in adults is infraspecifically stable in all species examined, interspecifically the lateromarginal plate may be broad, short and bar-like, or the innermost marginals may be shortened with the cutting area weakened to varying degrees. These considerations led Warén (1993) to include the North Atlantic species *Solariella obscura* (Couthony, 1838) and *S. varicosa* (Mighels and Adams, 1842) (Warén, 1993, fig. 4A, B, 6A–C) in *Solariella* together with *S. amabilis*, which they resemble in external anatomy but lack lateromarginal plates. Species with broad lateromarginal plates include the type species of *Microgaza* Dall, 1881, *Spectamen* Iredale, 1924 (? = *Solariella*), *Zeminolia* Finlay, 1926 (= *Solariella*), *Minolops* Iredale, 1929 (? = *Spectamen*), and *Archiminolia* Iredale, 1929. Species with shortened or

otherwise modified innermost marginal teeth include most species herein referred to *Zetela* Finlay, 1926, *Bathymophila* Dall, 1881 (Warén, 1990, p. 180; figures 130, 131 herein), and the type species of *Suavotrochus* Dall, 1924, *Hazuregyra* Shikama, 1962 (A. Warén, pers. comm.), and *Lamellitrochus* Quinn, 1991 (? = *Zetela*). The type species of *Zetela*, species of *Ilanga* Herbert, 1987, and *Solariella varicosa* and *S. obscura* have unmodified innermost marginal teeth.

Herbert (1987) provided evidence to suggest that local phylogenetic radiations (notably *Ilanga* off southern Africa) are recognizable from features of both radular and epipodial morphology. Epipodial features include number and relative size of the epipodial tentacles, presence or absence of flap-like projections (here termed epipodial lobes) from the epipodial fringe, and number of neck lobes. From observations of living specimens, Herbert (1987) recorded southern African species as having a tiny right postoptic tentacle, although I was unable to detect such a structure in any solariellines recorded herein (preserved material). Herbert (1987, p. 295) reported the existence of *Ilanga* species with four pairs of large epipodial tentacles in adults and three pairs in juveniles, which indicates that the number may increase during ontogenesis. One group (*Zetela*) is distinctive in having four pairs of epipodial tentacles, the two middle pairs of which are typically much smaller than the others. Many other species (e. g., of *Solariella sensu stricto* and *Spectamen*) have three pairs of epipodial tentacles and a prominent epipodial lobe on each side between the anterior pairs of tentacles. Judging from the fact that epipodial lobes have epipodial sense organs at their bases (Herbert, 1987, fig. 118), they would seem to be modified epipodial tentacles, which in turn suggests that four pairs of tentacles is plesiomorphic. Whether or not arrested development and/or transformation of epipodial tentacles occurs during ontogenesis remains to be established. These considerations, together with the existence in *Archiminolia oleacea* (Hedley and Petterd, 1906) of three right and four left epipodial tentacles and of three pairs in *A. meridiana* (Dell, 1953), both of which have very similar shells and radular morphologies, suggest that the number of epipodial tentacles has somewhat limited value for supraspecific grouping.

Solarielline shell sculpture may be predominantly spiral or axial, or it may be reticulate. Most species have rather stable shell sculpture, though *Solariella obscura* is exceedingly variable, ranging from strongly reticulately sculptured to almost smooth (Warén, 1993). Whereas many species are strongly sculptured throughout, others become more or less smooth following an initial spirally sculptured stage. The latter include the type species of *Microgaza*, *Bathymophila*, *Archiminolia*, and *Ilanga*. The type species of *Suavotrochus* is essentially smooth throughout. Species of *Bathymophila* are distinctive in that the umbilicus is covered by a thick callus with a granulate surface (produced by an internal layer of minute calcareous spheres). There is strong convergence in shell shape and sculpture in the group. For example

Ilanga biradiatula (Martens, 1902) and *I. laevissima* (Martens, 1881) (Herbert, 1987) resemble species of *Archiminolia* without umbilical septa in shell morphology, whereas *I. discus* Herbert, 1987, resembles the type species of *Microgaza*, yet they differ in radular morphology and external anatomy (unknown in *Microgaza*). Although solariellines (or at least solarielline-like species) have been recorded from as early as the Late Cretaceous (Hickman and McLean, 1990) and undoubted solariellines are known from the Eocene (Maxwell, 1992), the fossil record of the group is poor, and there are no documented lineages. Since it is thus impossible to establish character-state polarity, it seems likely that species in which the teleoconch becomes more or less smooth are derived from species with stronger, more persistent sculpture. Loss of sculpture, which presumably enhances sediment penetration, has probably occurred repeatedly in the group, almost certainly independently in *Solariella obscura*, *Microgaza/Bathymophila/Archiminolia*, *Ilanga*, and *Suavotrochus*, and quite possibly independently in *Microgaza*, *Bathymophila*, and *Archiminolia* as well. Influenced by the fact that most species with lateromarginal plates (apomorphic) have three pairs of epipodial tentacles (apomorphic), whereas those without lateromarginal plates have four pairs of epipodial tentacles (both plesiomorphic), I consider the prime candidate for a basal solarielline group to be *Zetela*, all species of which have strong spiral and (especially) axial sculpture. *Zetela* species are strikingly similar to species of *Calliotropis* Seguenza, 1903 (Eucyclinae), and, indeed, there are some similarities in external anatomy and radular morphology, the implication being that the groups have a common origin.

In the absence of any firm evidence for degree of relatedness, I have avoided the use subgenera or to lump heavily, and I interpret *Solariella*, *Microgaza*, *Bathymophila*, *Suavotrochus*, *Zetela*, *Archiminolia*, *Hazuregyra*, and *Ilanga* as distinct genera. *Solariella* apparently has a worldwide distribution, *Microgaza* western Atlantic and western Pacific, *Bathymophila* Atlantic and western Pacific, *Suavotrochus* western Atlantic, *Zetela* worldwide, *Archiminolia* western Pacific and possibly Indian Ocean, *Hazuregyra* northwestern Pacific, and *Ilanga* Indian Ocean and possibly western Pacific.

Higher classification follows Hickman and McLean (1990).

Genus *Solariella* Wood, 1842

Solariella Wood, 1842: 531. Type species (by monotypy): *Solariella maculata* Wood, 1842; Pliocene, England.

Solariella Friele, 1877: 311. Type species (by subsequent designation): *Solariella* Friele, 1877; Eocene, Trondheim, Norway. *Solariella affinis* Friele, 1877: 311. Type species (by subsequent designation): *Solariella affinis* Friele, 1877; Eocene, Trondheim, Norway. *Solariella* *obscura* Jeffreys, 1865; Recent, western Europe.

Solariella *philippensis* Watson, 1850: 152, 227. Type species (by original designation): *Solariella philippensis* Watson, 1850; Recent, Philippines.

Zeminolia (Wood, 1842) Watson, 1850: 152. Type species (by original designa-

tion): *Minolia plicatula* Murdoch and Suter, 1906; Recent, northern New Zealand.

?*Minolops* Iredale, 1929: 169. Type species (by original designation): *Minolia pulcherrima emendata* [sic—*emendata* treated as a full species on the same page by Iredale, 1929] Iredale, 1924; Recent, New South Wales.

Remarks: The animal of *Solariella amabilis* (preserved material, North Sea, 292–340 m, pers. obs.) has a broad right neck lobe, two smaller left neck lobes, three pairs of long, tapered epipodial tentacles, and a broad epipodial lobe between the two anterior tentacles on each side. The animal is essentially similar to those of *S. obscura* and *S. varicosa* (Warén, 1993, fig. 4A, B). The animal and radula (Warén, 1993, fig. 7B) are very similar to those of *Zeminolia plicatula* (preserved material, pers. obs.) and southern African *Spectamen* species (Herbert, 1987, fig. 118; NB "lnl" and "ml" are transposed in all illustrations of animals in this paper). Unfortunately the external anatomies of the type species of *Spectamen* and *Minolops* remain unknown (all available animals dry). Whereas all of the southern species of *Solariella* have lateromarginal plates, they may be present or absent in North Atlantic species (see above).

Spectamen philippensis and *Zeminolia plicatula* (figures 1–4) differ principally from *S. maculata*, *S. amabilis* (figure 40), and *S. cincta* in having much weaker axial sculpture on the teleoconch. *Zeminolia plicatula* differs further by having a wider umbilicus, a lower spire, sexually dimorphic shells, and by brooding its young within the umbilicus. Among New Zealand taxa here referred to *Solariella sensu stricto*, however, there is rather fluid interspecific gradation between the extremes in umbilical morphology, spire length, and sculpture (figures 1–12, 15–39, 41–47). In the apparent absence of any combination of character states by which *Solariella* and *Zeminolia* may be distinguished, it seems that *Zeminolia* should be treated as a synonym of *Solariella*. All of the New Zealand species of *Solariella* have a calcified periostracum (intrinsic), as in *Lamellitrochus* (Quinn, 1991), which is probably a synonym of *Zetela* (see below).

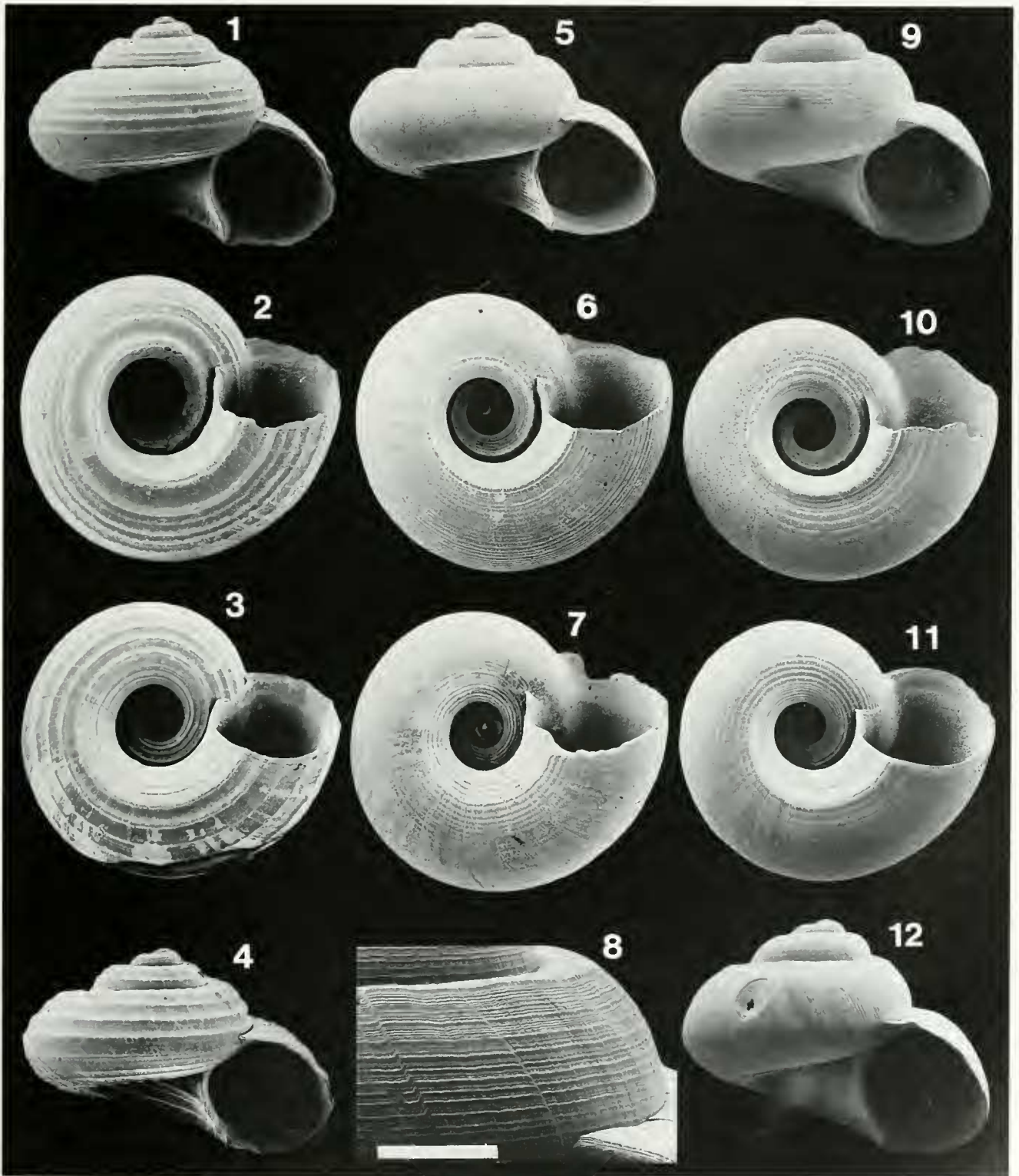
The type species of *Minolops* has unusually strong, crowded axial riblets on the teleoconch and is also distinctive in having fine axial sculpture on the outer part of the first half whorl of the protoconch (Herbert, 1987, fig. 214). The axial sculpture on the protoconch of *Minolops emendata* is evidently teleoconch sculpture that has been predisplaced into the larval stage by a heterochronic process.

Solariella plicatula (Murdoch and Suter, 1906)
(Figures 1–4, 13, 18, 41, 125)

Minolia plicatula Murdoch and Suter, 1906: 299, pl. 26, fig. 47–49.

Monilea (*Minolia*) *plicatula*.—Suter, 1913: 142, pl. 33, fig. 12.
Zeminolia plicatula.—Finlay, 1926: 359; Keen, 1960: 262, fig. 167/2; Herbert, 1987: fig. 215, 216.

Isanda (*Zeminolia*) *plicatula*.—Wenz, 1938: 318, fig. 719.



Figures 1–12. Shells of species of *Solariella* 1–4, *S. plicatula* (Murdoch and Suter), Rangaunu Bay, 63 m, M.130750. 1, 2. Females (1, 4.00 × 5.50 mm; 2, 4.00 × 5.65 mm). 3, 4. Males (3, 2.85 × 4.45 mm; 4, 2.95 × 4.55 mm). 5–7. *S. vera* (Powell) 5. Female, Middlesex Bank, 186–196 m, M.130064 (4.25 × 6.40 mm). 6. Female, E of Great Island, 100 m, M.130065 (4.20 × 6.10 mm). 7. Male, NE of Great Island, Three Kings Islands, 550 m, M.130062 (3.05 × 4.45 mm). 8–12. *S. luteola* (Powell). 8, 9. Female, off Northeast Island, Three Kings Islands, 102 m, M.34254 (2.90 × 4.40 mm). 10. Female, Middlesex Bank, 98–103 m, M.130051 (3.30 × 5.00 mm). 11. Male, Middlesex bank, 98–103 m, M.130051 (3.00 × 4.70 mm). 12. SW of Great Island, 440 m, M.130045 (3.45 × 4.90 mm). Scale = 250 μm.

Spectamen plicatulum.—Powell, 1976: 84; Powell, 1979: 64, pl. 17, fig. 19.

Spectamen verum.—Powell, 1979: 64 (remarks on *Spectamen* only); Hayward and Grace, 1981: text fig. 3; Hickman, 1992: 254. Not Powell, 1937.

Type material: Holotype NMNZ M.1124, from type locality, 22 January 1904, S.S. *Awarua*.

Type locality: Off Great Barrier Island, 36°08'S, 175°55'E, 201 m.

Other material examined (> 1000 specimens): N of North Cape, 34°20.0'S, 173°06.6'E, collected alive, 163–168 m, 27 January 1981, R/V *Tangaroa* (12, M.130088); off North Cape, 91 m, J.A. Bollons (2, M.2167); E of North Cape, 34°25.0'S, 173°13.1'E, 327–257 m, 27 January 1981, R/V *Tangaroa* (21, M.130086); Great Exhibition Bay, 34°33.4'S, 173°04.8'E, collected alive, 63 m, 27 January 1981, R/V *Tangaroa* (many, M.113347); Great Exhibition Bay, 34°33.6'S, 173°04.9'E, collected alive, 66 m, 27 January 1981, R/V *Tangaroa* (19, M.130067); SW of Cape Maria van Diemen, 34°41.9'S, 172°33.9'E, 103 m, 10 January 1981, R/V *Tangaroa* (2, M.131499); SW of Cape Maria van Diemen, 34°41.9'S, 172°33.5'E, 103 m, 10 January 1981, R/V *Tangaroa* (2, M.130087); off Cone Point, N of Whangaroa, collected alive, 44 m, September 1965, M.V. *Ikatere* (3, M.64330); NW of Whangaroa Harbour, 34°54.0'S, 173°42.6'E, 83 m, 26 January 1981, R/V *Tangaroa* (many, M.130767); off Flat Island, Whangaroa, 66 m, September 1965, M.V. *Ikatere* (1, M.64472); off Cape Brett, 35°08'S, 174°12.5'E, 80 m, 16 February 1974, R/V *Acheron* (25, M.35780); NE of Ninepin Rock, Bay of Islands, 35°08.8'S, 174°10.3'E, collected alive, 75 m, 1 December 1971, M.V. *Kokinga* (6, M.30767); between Redhead and Ninepin Rock and out, Bay of Islands, 35°09'S, 174°09'E, 46–51 m, 13 December 1973, M.V. *Kokinga* (1, M.40758); off Takau Bay, 35°10'S, 174°11'E, collected alive, 80 m, 16 February 1974, R/V *Acheron* (9, M.43652); off Ahipara, 35°10.4'S, 172°35.4'E, collected alive, 233 m, 11 January 1981, R/V *Tangaroa* (4, M.130089); off Takau Bay, 35°10.5'S, 174°10'E, 37 m, 16 February 1974, R/V *Acheron* (7, M.43501); Bay of Islands, 35°10.6'S, 174°15.4'E, 67–73 m, 12 February 1976, M.V. *Kokinga* (4, M.96005); Bay of Islands, 35°11.2'S, 174°16.7'E, collected alive, 58–64 m, 11 February 1976, M.V. *Kokinga* (18, M.96143); Deep Water Cove, Bay of Islands, 35°11.6'S, 174°18.1'E, collected alive, 23–32 m, 10 February 1976, M.V. *Kokinga* (many, M.95538); Bay of Islands, 35°11.6'S, 174°16.5'E, 54 m, 11 February 1976, M.V. *Kokinga* (18, M.95910); off island at entrance to Deep Water Cove, 35°11.9'S, 174°17.1'E, collected alive, 47–49 m, 11 February 1976, M.V. *Kokinga* (12, M.95720); between Hope Passage and North Cape, 35°12'S, 174°18'E, 37–40 m, 10 December 1971, M.V. *Kokinga* (1, M.41454); Deepwater Cove, 35°12'S, 174°18'E, 33–46 m, 6 December 1971, M.V. *Kokinga* (3, M.41499); between Hope Passage and North Cape, 35°12'S, 174°18'E, 37 m, 10 December 1971, M.V. *Kokinga* (1, M.41401); between sand flat and Great Barrier Island and Moturoa, Bay of Islands,

35°12'S, 174°06'E, collected alive, 31 m, 13 December 1973, M.V. *Kokinga* (5, M.41630); Bay of Islands, 35°12.5'S, 174°16.1'E, 40 m, 11 February 1976, M.V. *Kokinga* (2, M.95642); N of Poor Knights Islands, 35°22'S, 174°43'E, collected alive, 146 m, 15 February 1974, R/V *Acheron* (many, M.35115); W of Poor Knights Islands, 35°29'S, 174°43.5'E, collected alive, 110 m, 15 February 1974, R/V *Acheron* (18, M.35229); W of Poor Knights Islands, 35°32'S, 174°41'E, collected alive, 121–113 m, 15 February 1974, R/V *Acheron* (24, M.35876); off Poor Knights Islands, 79 m, March 1971 (3, M.44715); off Poor Knights Islands, 124 m, September 1965, M.V. *Ikatere* (6, M.39638); off Hen Island, 36°00.5'S, 174°43'E, 59 m, 13 February 1974, R/V *Acheron* (6, M.43809); off Hen Island, 48–55 m, J.A. Bollons (4, M.7242); off Tryphena, Great Barrier Island (1, M.91031); off Cuvier Island, 64 m and 70 m, J.A. Bollons (2, M.2165; 4, M.7241); 5 km E of Channel Island, Cape Colville, 137 m (1, M.2164); off Aldermen Islands, 165 m, 10 June 1970, B.L. Godfriaux (3, M.44386); off Aldermen Islands, 146 m, 26 May 1969, B.L. Godfriaux (3, M.44419); N of Aldermen Islands, 36°47.5'S, 176°00.0'E, 108–113 m, 24 January 1981, R/V *Tangaroa* (1, M.130068); SE of Aldermen Islands, 37°00.8'S, 176°12.3'E, collected alive, 178–248 m, 23 January 1979, R/V *Tangaroa* (many, M.65151); N of Mayor Island, 37°15.2'S, 176°14.5'E, 188–193 m, 22 January 1979, R/V *Tangaroa* (1, M.60979); off Mayor Island, 37°16.7'S, 176°17.5'E, 104–109 m, 22 January 1979, R/V *Tangaroa* (5, M.67411); off E side of Mayor Island, 37°18.9'S, 176°16.2'E, 59–74 m, 22 January 1979, R/V *Tangaroa* (5, M.65680); off Mayor Island, 37°22.5'S, 176°22'E, 207–220 m, 27 February 1957, M.V. *Alert* (1, M.12887); off SE side Mayor Island, 37–91 m, February 1986, G. Nicholson (1, M.92093); off White Island, 37°30.4'S, 177°09.7'E, collected alive, 83–92 m, 19 January 1979, R/V *Tangaroa* (4, M.130070); Rungapapa Knoll, WNW of White Island, 37°33.8'S, 176°59.0'E, 188–228 m, 20 January 1979, R/V *Tangaroa* (1, M.113498); W of Plate Island, 37°39.1'S, 176°31.5'E, 64–59 m, 21 January 1979, R/V *Tangaroa* (2, M.67638); between Motuhora and White islands, 37°40.2'S, 178°53.6'E, collected alive, 117 m, 2 May 1990, R/V *Akademik Alexander Nesmeyanov* (3, M.112438); N of New Plymouth, 38°40.2'S, 174°03.9'E, collected alive, 88 m, 13 January 1981, R/V *Tangaroa* (1, M.130069); N of New Plymouth, 38°40.4'S, 174°04.0'E, collected alive, 88 m, 13 January 1981, R/V *Tangaroa* (1, M.130093); N of New Plymouth, 38°55.0'S, 174°09.3'E, 48 m, 13 January 1981, R/V *Tangaroa* (4, M.130066).

Distribution (Figures 13, 48): Northern North Island: west coast from Ahipara to New Plymouth, east coast from North Cape to White Island, 31–257 m; collected alive at 31–ca. 248 m from sand and mud.

Remarks: Among New Zealand *Solariella* species, *S. plicatula* is distinctive in the combination of low spire, wide umbilicus, strong spiral cords on spire and base, and the color pattern of dull red sigmoidal bands on the spire and base. The intricacies of this species resolves as

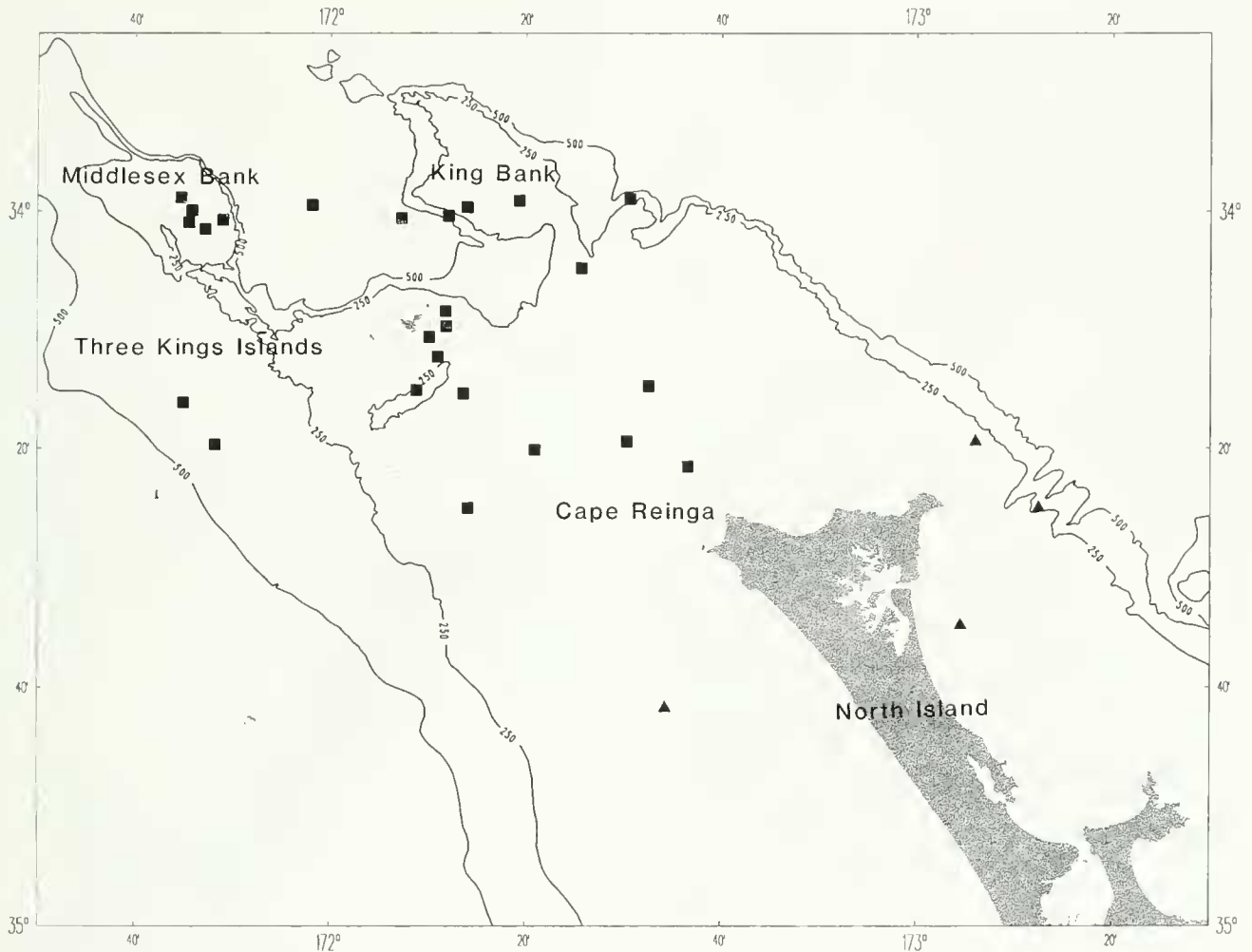


Figure 13. Map of Three Kings Islands and northern tip of North Island, New Zealand showing distributions of species of *Solariella* (250 and 500 m isobaths indicated): *S. plicatula* (Murdoch and Suter) (▲) and *S. luteola* (Powell) (■).

conspicuous, axial lines when the shell is (naturally) lightly solution-etched (figure 3).

Solariella plicatula is an umbilical brooder, specimens more than 2.5 mm wide having pronounced sexual dimorphism in shell size, shape and umbilicus morphology (figures 1–4). With increasing shell size, the umbilical rim in females becomes strongly angulate instead of remaining weakly angulate or evenly rounded as in males, the spiral thread at the umbilical rim becomes stronger and higher, the umbilical wall becomes steeper and more weakly sculptured or essentially smooth, the shell becomes slightly higher relative to its width, and the umbilicus may become narrower than in some males, though the volume (not measured) is greater because of the steeper wall and the produced rim: shell/umbilicus width ratio 1.70–2.30, mean = 2.08 (SD = 0.161, $n = 20$) in females, and 1.70–2.40, mean = 2.03 (SD = 0.190, $n = 20$) in males. Females also attain larger size than males (largest seen 7.00 mm wide, as against 5.50 mm). Note that in the boreal Pacific species *Margarites vorticiferus* (Dall, 1873), the only known trochid umbil-

ical brooder other than the present *Solariella* species, the umbilicus is both wider and more voluminous in females than in males (Lindberg and Dobberteen, 1981; Lindberg, 1985). Dobberteen and Ellmore (1986) found that shell dimorphism in *Margarites vorticiferus* is expressed even at the embryonic stage, and although shell dimorphism is not obvious in specimens of *S. plicatula* less than 2.5 mm wide, it remains to be checked.

In a sample of 240 specimens more than 2.5 mm wide taken off Rangunu Bay at 63 m depth (NMNZ M.130750), the female: male ratio is 1.12:1. Specimens with yolky egg capsules (8 or 10) within the umbilicus were obtained during the months of December, January (M.65151, M.130067), and May (Hayward and Grace, 1981 - misidentified as *S. vera*), and shelled larvae occurred during December and February (M.35115, M.41401).

The radula (figure 125) is typical of the genus, with broad lateromarginal plates. The jaw plates are extremely thin, with very weak elements along the leading edge only.

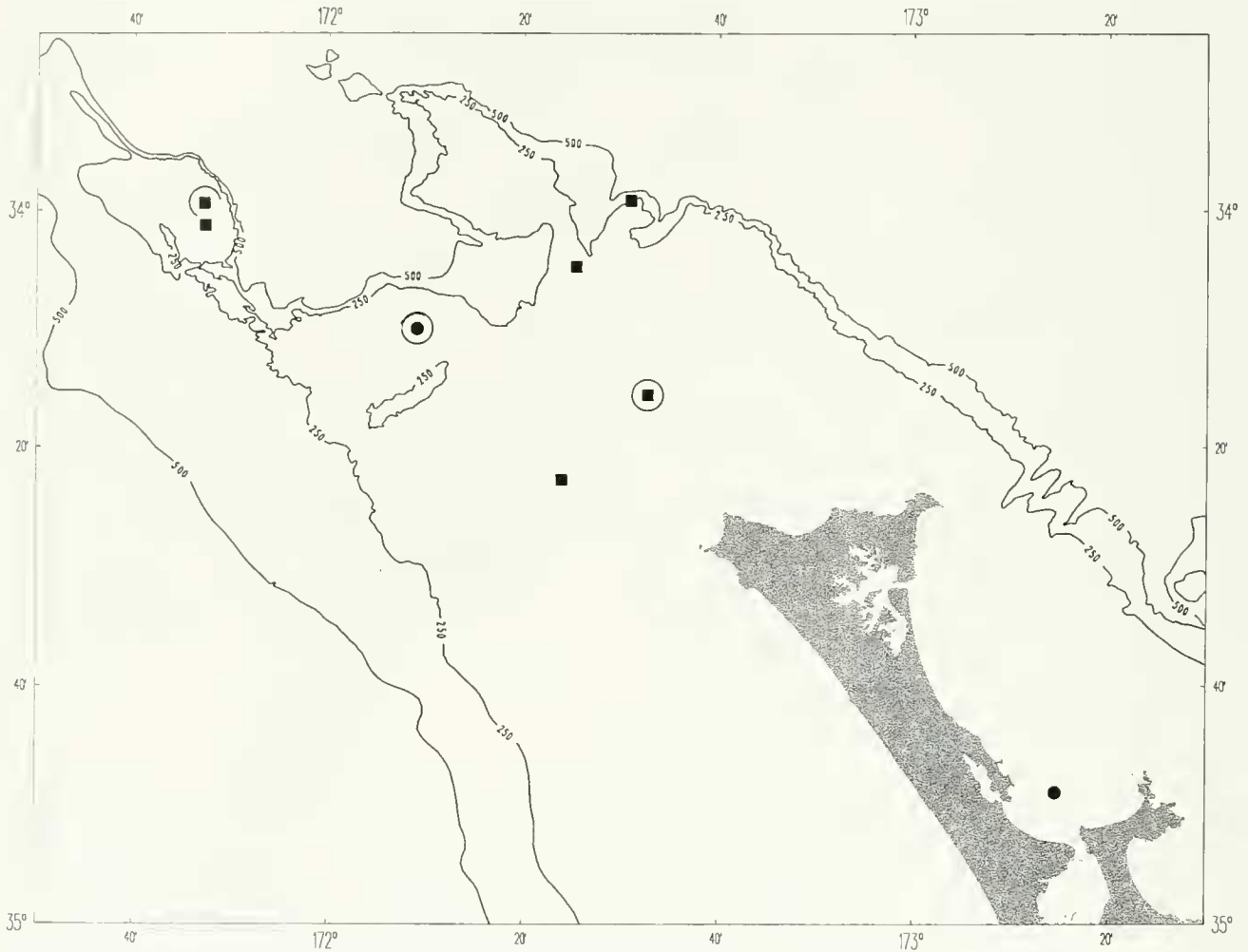


Figure 14. Map of Three Kings Islands and northern tip of North Island, New Zealand showing distributions of species of *Solariella* (250 and 500 m isobaths indicated): *S. vera* (Powell) (■), *S. exigua* new species (●) and *S. basilica* new species (○).

Solariella vera (Powell, 1937)
(Figures 5–7, 14, 42, 126)

Zeminolia vera Powell, 1937: 179, pl. 51, fig. 3
Spectamen verum.—Powell, 1976: 84; Powell, 1979: 64, pl. 17, fig. 17.
NOT *Spectamen verum*.—Powell, 1979: 64 (remarks on *Spectamen* only); Hayward and Grace, 1981: text fig. 3; Hickman, 1992: 254 = *Solariella plicatula*.

Type material: Holotype (3.55 × 5.30 mm, 3.30 TW, ambulans 200 mm wide) BMNH 1962962, from type locality, Middlesex Bank, 1932, R.R.S. *Discovery II*.

Type locality: Spirits Bay, 34°21.0'S, 172°48.0'E, 59 m.

Other material examined (152 specimens NMNZ): 37 km ENE of Great Island, Three Kings Islands, 33°58.0'S, 172°24.6'E, 250 m, 25 June 1978, R/V *Tangaroa* (28, M.130063); Middlesex Bank, NW of Three Kings Islands, 34°02.1'S, 171°45.3'E, collected alive, 186–196 m, 31 January 1981, R/V *Tangaroa* (20,

M.130064); Middlesex Bank, 34°02.1'S, 171°45.3'E, collected alive, 221–206 m, 31 January 1981, R/V *Tangaroa* (5, M.130063); 22 km ENE of Great Island, Three Kings Islands, 34°05.0'S, 172°24.6'E, 200 m, 24 June 1978, R/V *Tangaroa* (92, M.130061); 33 km E of Great Island, 34°14.2'S, 172°32.4'E, 100 m, 24 June 1978, R/V *Tangaroa* (7, M.130065).

Distribution (Figure 14): Middlesex Bank, Three Kings Islands, and off Spirits Bay, 59–550 m; collected alive at 186–221 m from comminuted bryozoan/shell substratum with sponges, corals, hydroids, etc.

Remarks: *Solariella vera* resembles *S. plicatula* in color pattern and shell shape, but differs in having much finer, more numerous spiral threads on the teleoconch. With the exception of a few specimens from the extreme south of its range (see below), *S. vera* lacks the low, rounded axial pleats on the spire and base characteristic of *S. plicatula*. The protoconch in *S. vera* is typically white, rarely pale yellow. The first one or two teleoconch

whorls may be yellow or white; subsequent whorls are typically white with narrow, widely spaced, pale red axial bands that are confined to the spire and do not extend beyond the periphery; the bands are typically absent from a broad subsutural zone but do extend to the suture in a few specimens (e. g., M.130065). A few specimens lack color bands. No specimens have been found brooding young within the umbilicus, though from the size of the umbilicus, it may also be an umbilical brooder. The shell appears to be sexually dimorphic, putative females having an angulate instead of rounded umbilical rim bordered by a considerably stronger spiral thread than in putative males (figures 5–7). Unlike *S. plicatula* and *S. luteola*, which have sex ratios of about 1:1, the ratio of putative females to males in *S. vera* would seem to be more than 18.4:1. Whether the five putative males are simply phenotypic variants of females that otherwise happen to resemble males in shell morphology is unclear. Powell's (1979), Hayward and Grace's (1981), and Hickman's (1992) records of brooding in *S. vera* are based on misidentified specimens of *S. plicatula*.

The radula (figure 126) is typical of the genus, with rather narrow lateromarginal plates. The jaw plates are thin, with rather well-developed elements covering most of the central area from the leading edge almost to the back edge.

Solariella luteola (Powell, 1937)
(Figures 8–12, 13, 19, 43, 127)

Zeminolia luteola Powell, 1937: 179, pl. 51, fig. 1, 2.

Spectamen luteolum.—Powell, 1976: 84; Powell, 1979: 64, pl. 17, fig. 15, 16.

Type material: Holotype BMNH 1962960 and paratype (1962961), from type locality, 17 August 1932, R.R.S. *Discovery II*.

Type locality: Off Three Kings Islands, 34°13.3'S, 172°12.0'E, 260 m.

Other material examined (477 specimens NMNZ): Middlesex Bank, NW of Three Kings Islands, 33°57.0'S, 171°45.4'E, collected alive, 98–103 m, 31 January 1981, R/V *Tangaroa* (20, M.130051); King Bank, N of Three Kings Islands, 33°57.0'S, 172°19.0'E, 128 m, 1 February 1981, R/V *Tangaroa* (9, M.130048); King Bank, 33°57.4'S, 172°19.4'E, collected alive, 128–123 m, 1 February 1981, R/V *Tangaroa* (11, M.72040); 37 km NE of Great Island, Three Kings Islands, 33°58.0'S, 172°30.6'E, 550 m, 25 June 1978, R/V *Tangaroa* (4, M.130053); 18 km N of Great Island, 33°59.2'S, 172°13.6'E, 155 m, 23 June 1978, R/V *Tangaroa* (23, M.93551); Middlesex Bank, 33°59.9'S, 171°45.3'E, 186–196 m, 31 January 1981, R/V *Tangaroa* (11, M.130056); Three Kings Trough, NW of Three Kings Islands, 34°00'S, 171°55'E, 805 m, 15 July 1962, R.N.Z.F.A. *Tui* (20, M.130054); Middlesex Bank, 34°00.9'S, 171°44.7'E, collected alive, 201–216 m, 31 January 1981, R/V *Tangaroa* (52, M.130047); N of Three Kings Islands, 34°01'S, 172°07'E, 622 m, 18 February 1974, R/V *Acheron* (2, M.34620); Middlesex Bank, 34°01.2'S, 171°44.4'E, collected alive, 206–211 m, 31 January 1981, R/V *Tangaroa* (12, M.130044); Middlesex Bank, 34°01.4'S, 171°45.2'E, collected alive, 201–216 m, 31 January 1981, R/V *Tangaroa* (5, M.130052); 13 km N of Great Island, 34°01.8'S, 172°12.0'E, 508 m, 23 June 1978, R/V *Tangaroa* (7, M.130046); Middlesex Bank, 34°02.0'S, 171°44.0'E, 246–291 m, 31 January 1981, R/V *Tangaroa* (44, M.130050); 37 km NW of Great Island, 34°02.0'S, 171°48.4'E, 188 m, 27 June 1978, R/V *Tangaroa* (7, M.130049); Middlesex Bank, 34°02.1'S, 171°45.8'E, collected alive, 221–206 m, 31 January 1981, R/V *Tangaroa* (50, M.130055); 22 km ENE of Great Island, 34°05.0'S, 172°24.6'E, 200 m, 24 June 1978, R/V *Tangaroa* (43, M.130059); off Northeast Island, Three Kings Islands, 34°08.5'S, 172°11'E, collected alive, 102 m, 18 February 1974, R/V *Acheron* (7, M.34254); off Three Kings Islands, 34°10'S, 172°12'E, 252 m, 19 February 1974, R/V *Acheron* (9, M.34019); off Three Kings Islands, 34°11'S, 172°10'E, 91 m, 19 February 1974, R/V *Acheron* (3, M.33753); SE of Great Island, 34°14.1'S, 172°09.0'E, collected alive, 192–202 m, 1 February 1981, R/V *Tangaroa* (10, M.130057); NW of Cape Reinga, 34°14.2'S, 172°32.4'E, 100 m, 24 June 1978, R/V *Tangaroa* (35, M.130058); SE of Great Island, 34°14.8'S, 172°13.6'E, 173–178 m, 2 February 1981, R/V *Tangaroa* (9, M.130091); 39 km SW of Great Island, 34°17.6'S, 171°45.3'E, 427 m, 21 June 1978, R/V *Tangaroa* (22, M.130043); 20 km NW of Cape Maria van Diemen, 34°20.0'S, 172°30.0'E, collected alive, 100 m, 20 June 1978, R/V *Tangaroa* (15, M.93744); SE of Three Kings Islands, 34°20.2'S, 172°21.8'E, collected alive, 121 m, 2 February 1981, R/V *Tangaroa* (21, M.130090); 37 km SW of Great Island, 34°20.4'S, 171°48.2'E, 440 m, 21 June 1978, R/V *Tangaroa* (18, M.130045); N of Cape Reinga, 34°21'S, 172°37'E, 88m, 19 February 1974, R/V *Acheron* (4, M.35915); 28 km S of Great Island, 34°24.0'S, 172°16.8'E, collected alive, 120 m, 20 June 1978, R/V *Tangaroa* (4, M.130092).

Distribution (Figure 13): Middlesex Bank, King Bank, Three Kings Islands, and off Cape Reinga, 88–805 m; collected alive at 98–202 m from comminuted bryozoan and shell substrata with sponges, hydroids, corals, etc.

Remarks: *Solariella luteola* is rather variable in sculpture, protoconch size, color and color pattern. The spire may be sculptured throughout with weak, crowded spiral threads, or all spirals other than a subsutural spiral may become obsolete on the second teleoconch whorl. The protoconch may be white or chrome yellow and ranges in width from 500 to 620 μm (mean = 560 μm). The first teleoconch whorl may be chrome yellow or pinkish white, and subsequent whorls are either uniform white or pinkish white or pinkish buff with the addition of narrow, pale red sigmoidal axial bands that entirely traverse the whorls to the umbilical rim, extending onto the umbilical wall in some specimens. Specimens from shallower than 200 meters are typically the most strongly

sculptured and pigmented, whereas specimens from depths greater than 400 meters are typically uniform white and weakly sculptured.

The radula (figure 127) is closest to that of *S. plicatula*, differing in having more broadly angulate cutting areas on the lateral teeth. The jaw plates are extremely thin, with weak elements covering the anterior third.

S. luteola broods its young within the umbilicus and has sexually dimorphic shells, shells of females having a more voluminous umbilicus with a flatter, steeper wall than males, and a more prominent spiral cord at the umbilical rim (figures 8–12). The umbilical rim is strongly angulated in both sexes, unlike *S. plicatula* in which this is a characteristic of females alone. One specimen examined had a shelled embryo deep within the umbilicus, and another had two (M.130055), though to judge from the volume of the umbilicus, the number of young brooded at any one time is probably considerably greater than this.

Compared with *S. vera*, which it most closely resembles, *S. luteola* differs in that spiral sculpture on the spire is more or less obsolete or consists of finer, closer, more numerous spiral threads, in that the protoconch is generally larger (mean = width 560 μm , cf. 510 μm), and in that the color bands (when present) are more strongly sigmoidal and traverse the spire and the base instead of only the spire. *Solariella luteola* and *S. vera* have been taken together at several stations throughout their ranges, living sympatrically at 221–206 meters depth on Middlesex Bank (M.130055, M.130063). Specimens from the south side of the Johnson Trough (figure 13; M.130092, M.130058, M.93744, M.130090, M.35915), between the Three Kings Islands and Cape Reinga, attain smaller size than northern shells, and a few of them have rounded axial folds, characteristics that are enhanced to the southeast. Southern specimens with axial folds resemble *S. plicatula*, though they are otherwise indistinguishable from northern populations of *S. luteola* and they are not strictly morphologically intermediate.

Solariella exigua new species

(Figures 14–17, 21, 44)

Description: Shell up to 4.60 mm wide, wider than high, of moderate thickness, widely umbilicate. Protoconch white; first 1.2–1.3 teleoconch whorls yellow; subsequent whorls white with dull red, irregular, typically subquadrate, axial maculations on abapical two thirds of whorls. Protoconch 430–480 μm wide, sculptured with axial nodules and a fine spiral thread, tip of apical fold bluntly rounded. Teleoconch up to 3.0 convex whorls; first whorl rather evenly convex, subsequent whorls horizontal or outwardly adapically sloping to the periphery. Last adult whorl slightly flattened above and below at periphery. Primary sculpture of fine, crowded spiral threads that multiply by intercalation, 5–13 on penultimate whorl and 25 on base in adults, innermost basal spiral at umbilical rim; spire spirals stronger and

angulate in section, with interspaces wider than each spiral; basal spiral finer and rounded in section, with interspaces narrower than each spiral except beside umbilical rim. Secondary sculpture of weak axial pleats confined to adapical third on spire on last adult whorl, fine collabral growth lines throughout. Umbilicus perspective to protoconch, diameter 41–46% of adult shell diameter, rim angulate; wall sculptured with spiral threads and fine collabral growth lines, last whorl more or less flat over outer two thirds. Aperture subcircular, lips thin and simple, thickest at angulation of umbilical rim.

Type material: Holotype NMNZ M.131480 and 6 paratypes NMNZ M.43711, from type locality, 18 February 1974, R/V *Acheron*. Paratypes (16 NMNZ): middle Southeast Bay, Great Island, 34°10'S, 172°08'E, collected alive, 42–46 m, 18 February 1974, R/V *Acheron* (14 NMNZ M.33833, 1 AMS), Southeast Bay, Great Island, 30 m, 5 February 1993, F. Brook (2, M.117426).

Type locality: Middle Southeast Bay, Great Island, Three Kings Islands, 34°10'S, 172°08'E, 42–46 m.

Other material examined: Off Rangaunu Bay, 34°49.6'S, 173°15.0'E, 23 m, 27 January 1981, R/V *Tangaroa* (7, M.130071).

Distribution (Figure 14): Off Three Kings Islands, and off Rangaunu Bay, 23–55 m, living at 42–46 m on gravel; dead shells on comminuted bryozoan/shell or shell substrata.

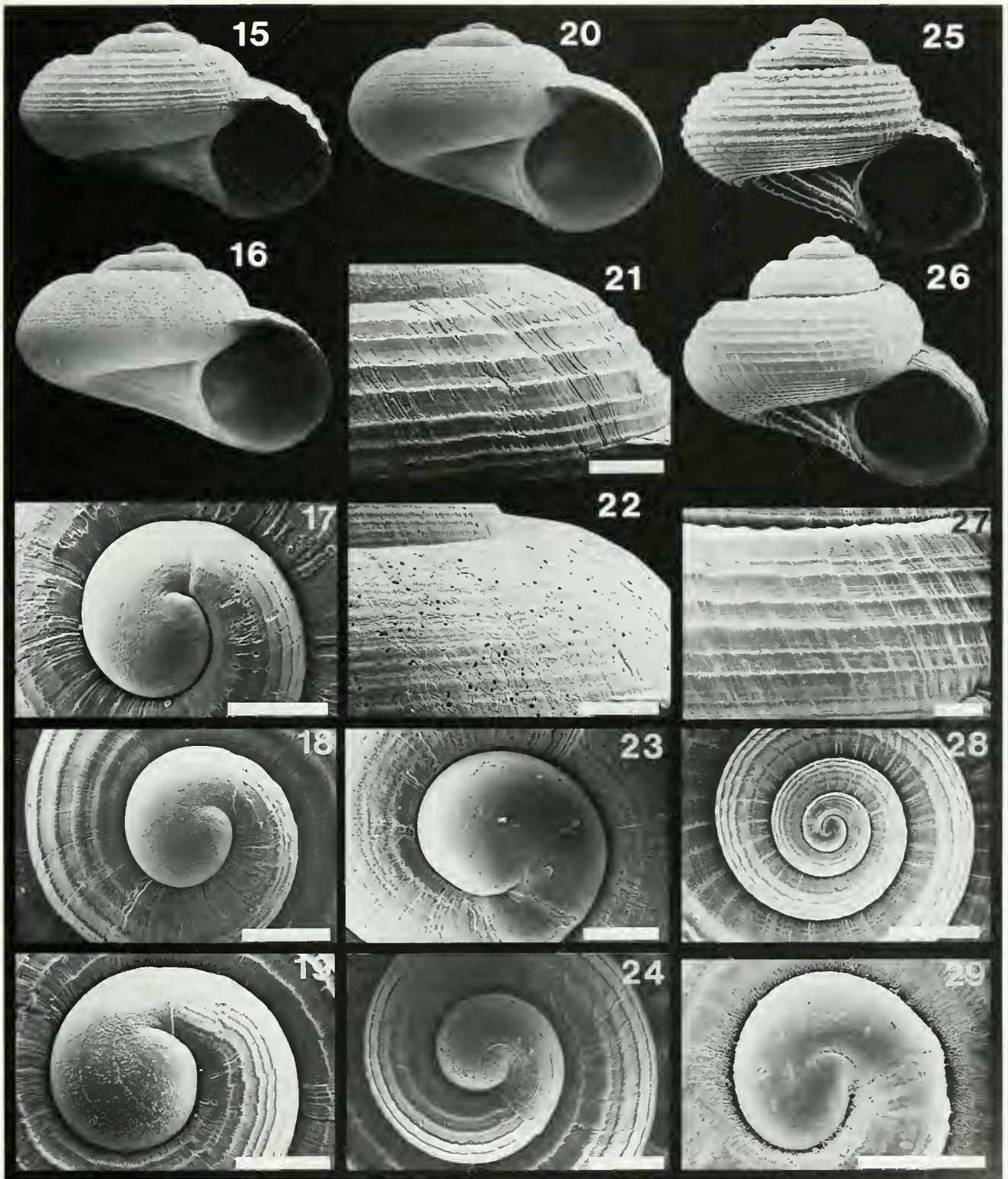
Remarks: *Solariella exigua* most closely resembles *S. plicatula* and *S. vera*, differing from both in having finer, closer, more numerous spiral threads on the spire, a smaller protoconch (width 430–480 μm : mean = 462 μm , cf. 470–530 μm : mean = 498 μm and 500–530 μm : mean = 510 μm), and in attaining smaller size (maximum width 4.60 mm, cf. 7.00 mm and 5.20 mm). It differs further from both in showing no obvious sexual dimorphism in the shell.

Etymology: Little (Latin).

Solariella basilica new species

(Figures 14, 20, 22, 23)

Description: Shell up to 8.90 mm wide, wider than high, of moderate thickness, widely umbilicate. Protoconch white; first 1.0–1.3 teleoconch whorls yellow, fading over next half whorl to white, subsequent whorls uniform white. Protoconch 600 μm wide, smooth, tip of apical fold bluntly rounded. Teleoconch up to 3.75 convex whorls; first whorl rather evenly convex, subsequent whorls with horizontal sutural ramp with rounded rim, last adult whorl slightly flattened above and below rounded periphery. Primary sculpture of fine, crowded spiral threads that multiply by intercalation, angulate in section on spire, rounded in section on base, 17 on penultimate whorl and about 30 on base (subadult holotype), 20 on penultimate whorl and 22 on base (adult paratype), innermost basal spiral at umbilical rim. Fine



Figures 15–29. Shells of species of *Solariella*. **15–17, 21.** *S. exigua* new species. **15, 17, 21.** Holotype, Southeast Bay, Great Island, Three Kings Islands, 42–46 m, M.131480 (2.40 × 4.00 mm). **16.** Paratype, Southeast Bay, 55 m, M.33833 (2.90 × 4.55 mm). **18.** *S. plicatula* (Murdoch and Suter), off Poor Knights Islands, 146 m, M.35115. **19.** *S. luteola* (Powell), off Northeast Island, Three Kings Islands, 102 m, M.34254. **20, 22, 23.** *S. basilica* new species, holotype, Southeast Bay, 55 m, M.131557. **24, 25.** *S. semireticulata* (Suter). **24.** E of Forty Fours, Chatham Islands, 238 m, M.10837. **25.** SE of Nugget Point, Otago, 140 m, M.59359 (3.55 × 4.80 mm). **26–29.** *S. tryphienensis* (Powell), off Te Arai Point, 35 m, M.130840 (4.30 × 5.40 mm). Scale 28 = 1 mm; others = 250 µm.

collabral growth lines throughout. Umbilicus perspective to protoconch, diameter 33% (adult)–38% (subadults) of shell diameter, rim angulate, projecting inwards at maturity to overhang outer umbilical wall; wall of each whorl steep, sculptured with low spiral threads and fine collabral growth lines. Aperture subcircular, lips thin and simple, thickest at angulation of umbilical rim.

Type material: Holotype (2.50 × 3.80 mm, subadult) NMNZ M.131557 and 2 subadult paratypes (M.33828), from type locality, 18 February 1974, R/V *Acheron*. Paratypes: Middlesex Bank, NW of Three Kings Islands, 33°59.9'S, 171°45.3'E, 186–196 m, 31 January 1981, R/V *Tangaroa* (1 adult, M.131481); NW of Cape Reinga, 34°14.2'S, 172°32.4'E, 100 m, 24 June 1978, R/V *Tangaroa* (1 subadult, M.131539).

Type locality: Outer Southeast Bay, Great Island, Three Kings Islands, 34°10'S, 172°08'E, 55 m.

Distribution (Figure 14): Off Great Island, Three Kings Islands, and Middlesex Bank, 55–196 m (dead), on gravel and comminuted bryozoan/shell substrata.

Remarks: *Solariella basilica* resembles *S. exigua* in having crowded spiral threads on the spire and base but differs in having finer, more numerous threads at equivalent stages of shell growth, in attaining much larger size (maximum width 8.90, cf. 4.60 mm), in having a wider protoconch (600 μm, cf. 430–480 μm) and a narrower umbilicus (33–38% instead of 41–46% of shell width), and in the last few teleoconch whorls being uniform white instead of axially banded. *Solariella basilica* differs from *S. vera* in having finer, more numerous spiral threads on the spire and base (basal spirals obsolete in *S. vera*). Empty shells of *S. basilica* occurred together with *S. exigua* at the type locality and with *S. vera* at Middlesex Bank (M.131481, M.130064).

Etymology: Royal (Greek).

Solariella semireticulata (Suter, 1908)
(Figures 24, 25, 48)

Monilea (*Minolia*) *semireticulata* Suter, 1908: 22, pl. 2, fig. 1; Suter, 1913: 142, pl. 33, fig. 13.

Spectamen semireticulata.—Powell, 1926: 44, 45.

Zeminolia semireticulata.—Finlay, 1926: 360; Powell, 1955: 55.

Spectamen semireticulatum.—Powell, 1976: 84; Powell, 1979: 64, pl. 17, fig. 18.

Type material: Lectotype (Boreham, 1959) NZGS TM467

Type locality: Off the Snares Islands, 91 m.

Other material examined (88 specimens NMNZ): Pegasus Bay, NE of Banks Peninsula, 43°31.0'S, 173°59.1'E, collected alive, 256–293 m, 21 February 1979, R/V *Moana* (1, M.94717); Papanui Canyon, off Otago Peninsula, 45°11.2'S, 171°00'E, 348–220 m, 15 February 1978, R/V *Acheron* (2, M.94629); Saunders Canyon, off East Otago, 45°56'S, 170°54'E, 360 m, 30 June 1975, R/V *Moana* (1, M.48847); off Taiere, Dun-

edin, 46°12.0'S, 170°41.5'E, 150 m, 1 September 1976, R/V *Munida* (2, M.65802); Saunders Canyon, off East Otago, 45°56'S, 170°54'E, 420 m, 27 October 1967, R/V *Munida* (1, M.28426); SE of Nugget Point, East Otago, 46°40'S, 170°00'E, 140 m, 27 March 1978, F.R.V. *James Cook*, coll. L. Paul (20, M.59359); 0.8 km SW of Hare's Ears, Doubtful Sound entrance, 45°17.2'S, 166°49.3'E, collected alive, 146 m, 7 January 1977, R/V *Acheron* (24, 58783); E of Forty Fours, Chatham Islands, 44°04'S, 175°23.5'W, collected alive, 238 m, 1 February 1954, M.V. *Alert* (13, M.10837).

Distribution (Figure 48): East coast of South Island, Doubtful Sound, Chatham Rise, also Snares and Auckland islands (Powell, 1955), 91–421 m; collected alive at 146–238 m from sand and shell substrata.

Remarks: *Solariella semireticulata* differs from the superficially similar species *S. plicatula* in having stronger teleoconch sculpture, in being uniform white, and in that the umbilical rim is consistently rounded. Unlike *S. plicatula*, *S. semireticulata* exhibits no obvious shell dimorphism and is probably not an umbilical brooder.

Solariella tryphenensis (Powell, 1930)
(Figures 26–29, 45, 49)

Zeminolia tryphenensis Powell, 1930: 534, pl. 62, fig. 16–18.
Spectamen tryphenense.—Powell, 1976: 84; Powell, 1979: 65, pl. 17, fig. 12–14.

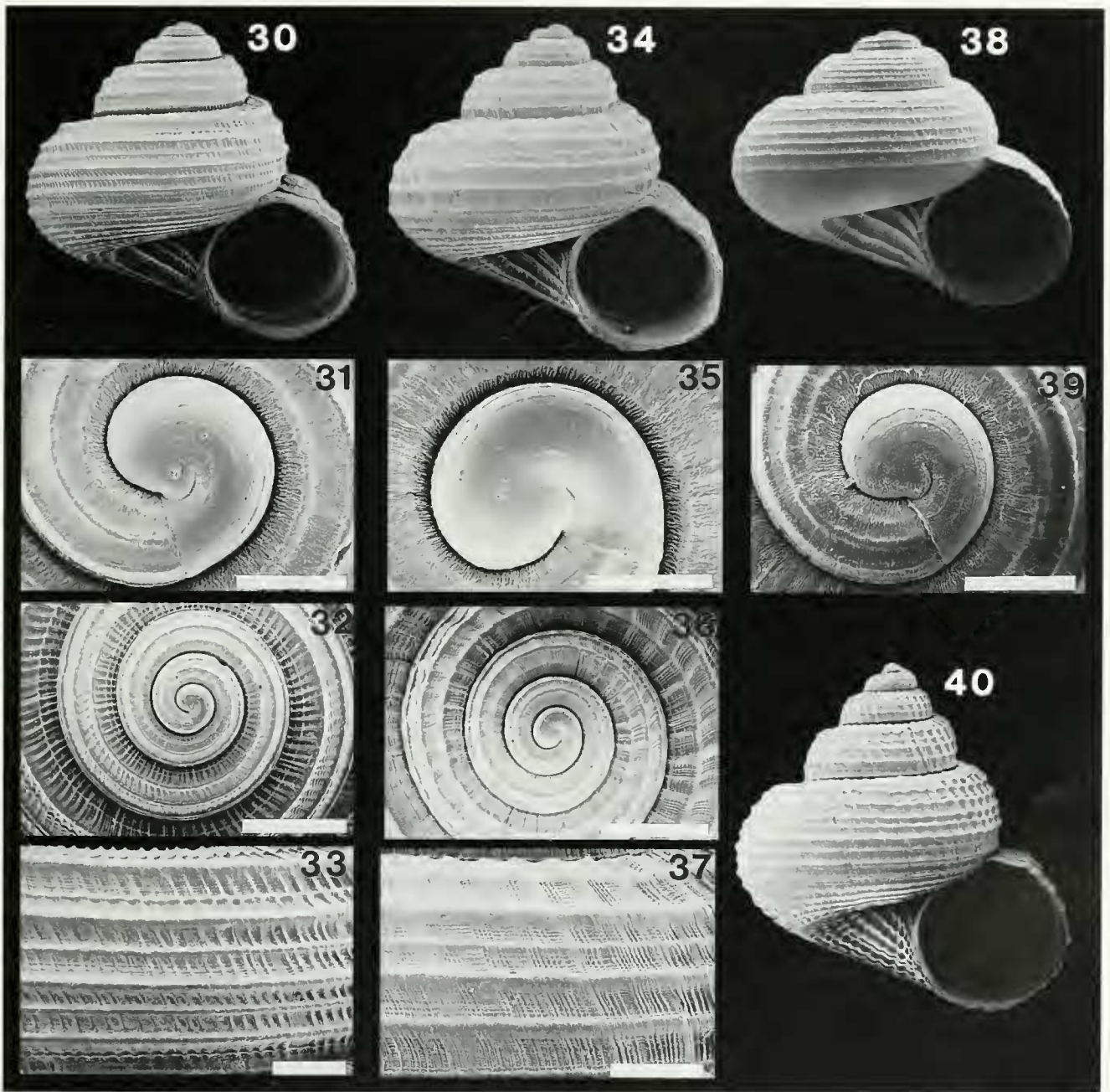
Type material: Holotype AIM AK72175, from type locality.

Type locality: Tryphena Bay, Great Barrier Island, 11 m.

Other material examined (many specimens NMNZ): Great Exhibition Bay, 34°33.4'S, 173°04.8'E, 63 m, 27 January 1981, R/V *Tangaroa* (51, M.113337); off Twin Rocks, Bay of Islands, 35°10'S, 174°18'E, 46–73 m, 10 December 1973, M.V. *Kokinga* (2, M.42245); off Motuwheke Island, Bay of Islands, 35°12'S, 174°17'E, 22–31 m, 14 December 1973, M.V. *Kokinga* (1, M.41864); SE of Te Arai Point, Mangawhai, Northland, 36°10.5'S, 174°42.0'E, collected alive, 35 m (dredged for beach replenishment at Mission Bay, Auckland) 3 March 1996, B.A. Marshall and N.J. Peterson (10, M.130840), B.F. Hazelwood, 1996 (51, M.131392), P. Poortman (many, M.131712); off Mayor Island, 37°16.7'S, 176°17.5'E, 104–109 m, 22 January 1979, R/V *Tangaroa* (10, M.67431) off E side of Mayor Island, 37°18.9'S, 176°16.2'E, 59–74 m, 22 January 1979, R/V *Tangaroa* (102, M.65681).

Distribution (Figure 49): Northeastern North Island, from Great Exhibition Bay to Mayor Island, 11–109 m, collected alive at 35 m on clean sand and shell substratum.

Remarks: Among New Zealand *Solariella* species, *S. tryphenensis* is characterized by its large size and strong



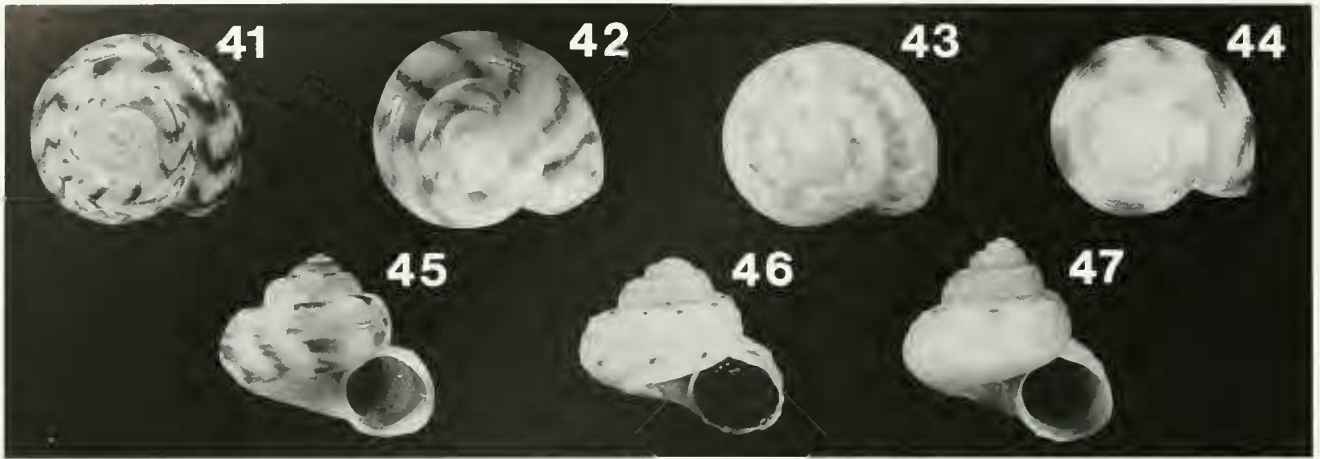
Figures 30–40. Shells of species of *Solariella*. **30–33.** *S. benthicola* (Powell), Middlesex Bank, 221–206 m, M.130079 (5.30 × 5.80 mm). **34–37.** *S. peristicta* new species, holotype, NW of Cape Reinga, 78 m, M.131563 (4.55 × 5.05 mm). **38, 39.** *S. flavida* new species, holotype, NW of Cape Reinga, 100 m, M.131564 (3.30 × 4.40 mm). **40.** *S. amabilis* (Jeffreys), Snorre oil field, N North Sea, 292–340 m, Swedish Museum of Natural History (4.20 × 4.30 mm). Scales 32, 36 = 1 mm, others = 250 μ m.

sculpture, and in being pale buff with a deep red (sel-dom brown) color pattern of subsutural maculations and irregular, wavy axial bands that extend from the maculations to about midway across the base. *S. tryphenensis* ranges into shallower water than other New Zealand species, perhaps as shallow as 11 meters, and it has an extremely patchy distribution.

Solariella benthicola (Powell, 1937)
(Figures 30–33, 46, 48, 128)

Zeminolia benthicola Powell, 1937: 180, pl. 51, fig. 4.
Spectamen benthicola.—Powell, 1976: 84; Powell, 1979: 64

Type material: Holotype BMNH 1962963, from type locality, 17 August 1932, R.R.S. *Discovery II*.



Figures 41–47. Shells of species of *Solariella*. **41.** *S. plicatula* (Murdoch and Suter), off Rangaunu Bay, 63 m, M.130750 (4.00 × 5.65 mm). **42.** *S. vera* (Powell), ENE of Great Island, Three Kings Islands, 200 m, M.130061 (5.05 × 7.50 mm). **43.** *S. luteola* (Powell), Middlesex Bank, 98–103 m, M.130051 (4.40 × 6.40 mm). **44.** *S. exigua* new species, paratype, Southeast Bay, Three Kings Islands, 55 m, M.33833 (2.85 × 4.50 mm). **45.** *S. tryphenensis* (Powell), off Te Arai Point, 35 m, M.130840 (4.80 × 5.70 mm). **46.** *S. benthicola* (Powell), Middlesex Bank, 221–206 m, M.130079 (5.35 × 5.60 mm). **47.** *S. peristicta* new species, NW of Cape Reinga, 78 m, M.131492 (4.15 × 4.60 mm).

Type locality: Off Three Kings Islands, 34°13.3'S, 172°12.0'E, 260 m.

Other material examined (114 specimens NMNZ): 18 km N of Great Island, Three Kings Islands, 33°59.2'S, 172°13.6'E, 155 m, 23 June 1978, R/V *Tangaroa* (4, M.130073); Middlesex Bank, NW of Three Kings Islands, 33°59.9'S, 171°45.3'E, 186–196 m, 31 January 1981, R/V *Tangaroa* (15, M.130076); Three Kings Trough, NW of Three Kings Islands, 34°00'S, 171°55'E, 805 m, 15 July 1962, R.N.Z.F.A. *Tui* (30, M.48959); Middlesex Bank, 34°00.9'S, 171°44.7'E, collected alive, 201–216 m, 31 January 1981, R/V *Tangaroa* (2, M.130077); N of Three Kings Islands, 34°01'S, 172°07'E, 622 m, 18 February 1974, R/V *Acheron* (2, M.130083); 13 km N of Great Island, 34°01.8'S, 172°12.0'E, 508 m, 23 June 1978, R/V *Tangaroa* (6, M.131501); Middlesex Bank, 34°02.0'S, 171°44.0'E, 246–291 m, 31 January 1981, R/V *Tangaroa* (10, M.130081); 37 km NW of Great Island, 34°02.0'S, 171°48.4'E, 188 m, 27 June 1978, R/V *Tangaroa* (2, M.130075); Middlesex Bank, 34°02.1'S, 171°45.8'E, collected alive, 221–206 m, 31 January 1981, R/V *Tangaroa* (5, M.130079); SE of Great Island, 34°14.1'S, 172°09.0'E, collected alive, 192–202 m, 1 February 1981, R/V *Tangaroa* (4, M.130078); NW of Cape Reinga, 34°14.2'S, 172°32.4'E, 100 m, 24 June 1978, R/V *Tangaroa* (1, M.130074); 39 km SW of Great Island, 34°14.2'S, 171°45.3'E, 427 m, 21 June 1978, R/V *Tangaroa* (1, M.130082); N of North Cape, 34°20.0'S, 172°09.0'E, collected alive, 163–168 m, 27 January 1981, R/V *Tangaroa* (1, M.131502); SE of Three Kings Islands, 34°20.2'S, 172°06.8'E, collected alive, 121 m, 2 February 1981, R/V *Tangaroa* (1, M.130080); 28 km S of Great Island, 34°24.0'S, 172°16.8'E, 120 m, 20 June 1978, R/V *Tangaroa* (1, M.130072); E of North Cape, 34°25.0'S,

173°13.1'E, 327–257 m, 27 January 1981, R/V *Tangaroa* (22, M.48959).

Distribution (Figure 48): Off Three Kings Islands and off North Cape, 100–805 m, collected alive at 121–216 m on comminuted bryozoan/shell substratum with sponges, corals, hydroids, etc.

Remarks: Among species from the New Zealand region, *Solariella benthicola* most closely resembles *S. tryphenensis*, differing principally in being smaller relative to the number of whorls (maximum width 5.90 mm, 4.3 TW cf. 6.70 mm, 4.1 TW); in having crisp axial riblets rather than low, rounded axial folds on the spire; and in being more sparsely pigmented. Specimens from the extreme south of its range and many from extreme depths have stronger, more widely spaced axial riblets than other material but seem likely to be conspecific.

The radula (figure 128) is typical of the genus, with rather narrow lateromarginal plates. The elements on the extremely thin jaw plates are weak and confined to the anterior half, weakening posteriorly.

Solariella peristicta new species
(Figures 34–37, 47, 49, 129)

Description: Shell up to 5.80 mm wide, slightly wider than high, of moderate thickness, umbilicate, almost lustreless. Periostracum apparently calcified (intritacal). Protoconch white. Teleoconch pale buff or white, spiral cords with small, irregular yellowish brown or pale red spots; paler, irregular, wavy axial bands on base and outer part of umbilicus; some specimens pinkish white with irregular, wavy, red axial bands that extend from suture into umbilicus; greenish nacre showing through translucent outer shell layers. Protoconch 130 µm wide,

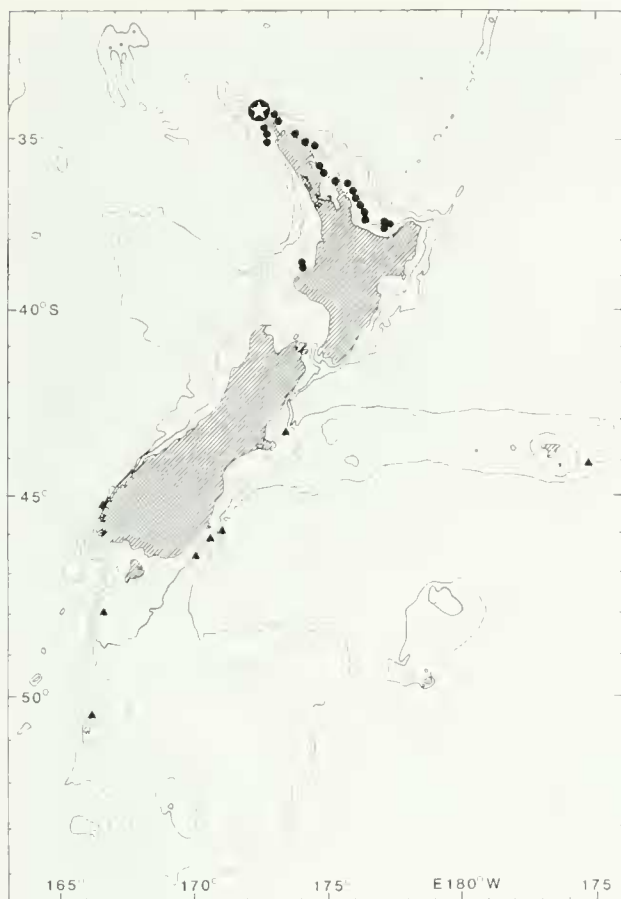


Figure 48. Map of New Zealand region showing distributions of species of *Solariella*: *S. plicatula* (Murdoch and Suter) (●), *S. semireticulata* (Suter) (▲), and *S. benthicola* (Powell) and *S. flavida* new species (★).

sculptured with 4 fine, crisp spiral threads and sparse granules, tip of apical fold pinched. Teleoconch up to 4.25 whorls. First whorl evenly convex, subsequent whorls with horizontal sutural ramp with angulate rim, rather evenly convex from ramp rim to suture within umbilicus. Primary sculpture of prominent, narrow spiral cords that multiply by intercalation and enlarge to resemble adjacent spirals, interspaces several times wider than each spiral; 4 on first 1.5 spire whorls, adapical 3 similar, abapical spiral more or less covered by succeeding whorls; adults with 6 on penultimate whorl and 11–14 on base and umbilical wall. Second and subsequent whorls traversed by low, rounded axial pleats, strongest on adapical half of each spire whorl, evanescent abapically. Fine, crisp, crowded collabral growth lines throughout; fine, crisp, interstitial spiral threads commencing after second whorl, becoming crowded throughout. Umbilicus perspective to protoconch, rim evenly rounded, wall of each whorl convex, sculptured with spiral cords and fine collabral and spiral threads. Aperture subcircular, lips thin and simple.

Radula (figure 129) typical of the genus, lateroniar-

ginal plates rather narrow. Jaw plates very thin, weak elements confined to the anterior half.

Type material: Holotype NMNZ M.131563 and 3 paratypes M.131492, from type locality, 2 February 1981, R/V *Tangaroa*, collected alive. Paratypes (14): Middlesex Bank, NW of Three Kings Islands, 33°57.0'S, 171°45.4'E, collected alive, 98–103 m, 31 January 1981, R/V *Tangaroa* (5, M.131493); King Bank, N of Three Kings Islands, 33°57.4'S, 172°19.4'E, collected alive, 128–123 m, 1 February 1981, R/V *Tangaroa* (8 NMNZ M.131494, 1 AMS).

Type locality: NW of Cape Reinga, 34°25.0'S, 172°27.8'E, 78 m.

Other material examined (100 specimens NMNZ): King Bank, N of Three Kings Islands, 33°57.4'S, 172°19.4'E, 128–123 m, 1 February 1981, R/V *Tangaroa* (13, M.130084); Three Kings Trough, NW of Three Kings Islands, 34°00'S, 171°55'E, 805 m, 15 July 1962, R.N.Z.F.A. *Tui* (5, M.130085); N of Three Kings Islands, 34°01'S, 172°07'E, 622 m, 18 February 1974, R/V *Acheron* (6, M.34619); Middlesex Bank, NW of Three Kings Islands, 34°01.2'S, 171°44.4'E, 206–211 m, 31 January 1981, R/V *Tangaroa* (3, M.131496); Middlesex Bank, 34°02.0'S, 171°44.0'E, 246–291 m, 31 January 1981, R/V *Tangaroa* (5, M.131495); 11 km NW of Great Island, Three Kings Islands, 34°06.5'S, 172°04.7'E, 310 m, 30 June 1978, R/V *Tangaroa* (2, M.61461); off Northeast Island, Three Kings Islands, 34°08.5'S, 172°11'E, collected alive, 102 m, 18 February 1974, R/V *Acheron* (13, M.34253); outer Southeast Bay, Great Island, 34°10'S, 172°08'E, 55 m, 18 February 1974, R/V *Acheron* (4, M.33825); off Three Kings Islands, 34°10'S, 172°12'E, 252 m, 19 February 1974, R/V *Acheron* (5, M.34024); Arch Pinnacle, Princes Islands, Three Kings Islands, 40 m, 10 March 1983, F. Brook (1, M.109336); 39 km SW of Great Island, 34°17.6'S, 171°45.3'E, 427 m, 21 June 1978, R/V *Tangaroa* (5, M.131500); N of Cape Reinga, 34°21'S, 172°37'E, 88 m, 19 February 1974, R/V *Acheron* (4, M.35912); off Ranganui Bay, 34°42.8'S, 173°14.5'E, 63 m, 27 January 1981, R/V *Tangaroa* (32, M.130751); NW of Whangaroa Harbour, 34°54.0'S, 173°42.6'E, 83 m, 26 January 1981, R/V *Tangaroa* (1, M.130768); ENE of Great Barrier Island, vicinity of 35°43'S, 176°18'E, 329 m, 21 July 1962, R.N.Z.F.A. *Tui* (1, M.44047).

Distribution (Figure 49): Off Three Kings Islands, and northeastern North Island as far south as Great Barrier Island, 40–805 m, collected alive at 78–128 m on comminuted bryozoan/shell substrata with sponges, corals, hydroids, etc.

Remarks: Compared with *Solariella tryphenensis*, which it most resembles, *S. peristicta* differs in attaining smaller size (width up to 5.80 mm cf. 6.70 mm) and in having crisper, more crowded collabral axial riblets on the last few whorls that produce a fine reticulation with the secondary spiral threads. *Solariella peristicta* resem-



Figure 49. Map of New Zealand region showing distributions of species of *Solariella*: *S. tryphenensis* (Powell) (▲) and *S. peristicta* new species (■).

bles the sympatric species *S. benthicola* in size, shape, and radular morphology but has much coarser axial sculpture.

Etymology: Dappled (Greek).

Solariella flavida new species
(Figures 35, 39, 48)

Description: Shell up to 5.05 mm wide, slightly wider than high, of moderate thickness, umbilicate. Periostracum apparently calcified (intrinsic). Protoconch white. First 2.5 teleoconch whorls yellow, sutural ramp white; subsequent whorls white with pale yellow subsutural maculations and pale yellow, irregular axial bands that extend to either shallowly across base or deep into umbilicus. Protoconch 2.5 whorls, 200 µm wide, sculptured with 5 fine, crisp spiral cords and crowded granules, tip of apical fold moderate. Teleoconch up to 3.75 whorls with narrow spiral cords, horizontal sutural ramp; rather evenly sculptured from top to suture within umbilicus. Primary sculpture of prominent, narrow spiral cords that multiply by intercalation and enlarge to resemble adja-

cent spirals, strong on spire, strongest on inner third of base and umbilical wall, interspaces several times wider than each spiral, finer and crowded on outer part of base; 4 on first spire whorl, apical 3 similar, abapical spiral more or less covered by succeeding whorls; adults with 8 or 9 on penultimate whorl, 20–25 on base and umbilical wall. Second and subsequent whorls traversed by weak, inconspicuous, rounded axial pleats, strongest on spire, evanescent on base. Fine, crisp, crowded collabral growth lines throughout; fine, crisp spiral threads commencing after first whorl, becoming crowded and covering interspaces on spire, base, and umbilical wall. Umbilicus perspective to protoconch, rim evenly rounded, whorl of each whorl convex, sculptured with spiral cords and fine collabral and spiral threads. Aperture sub-circular, lips thin and simple. Radula unknown (only available live-taken specimens decayed).

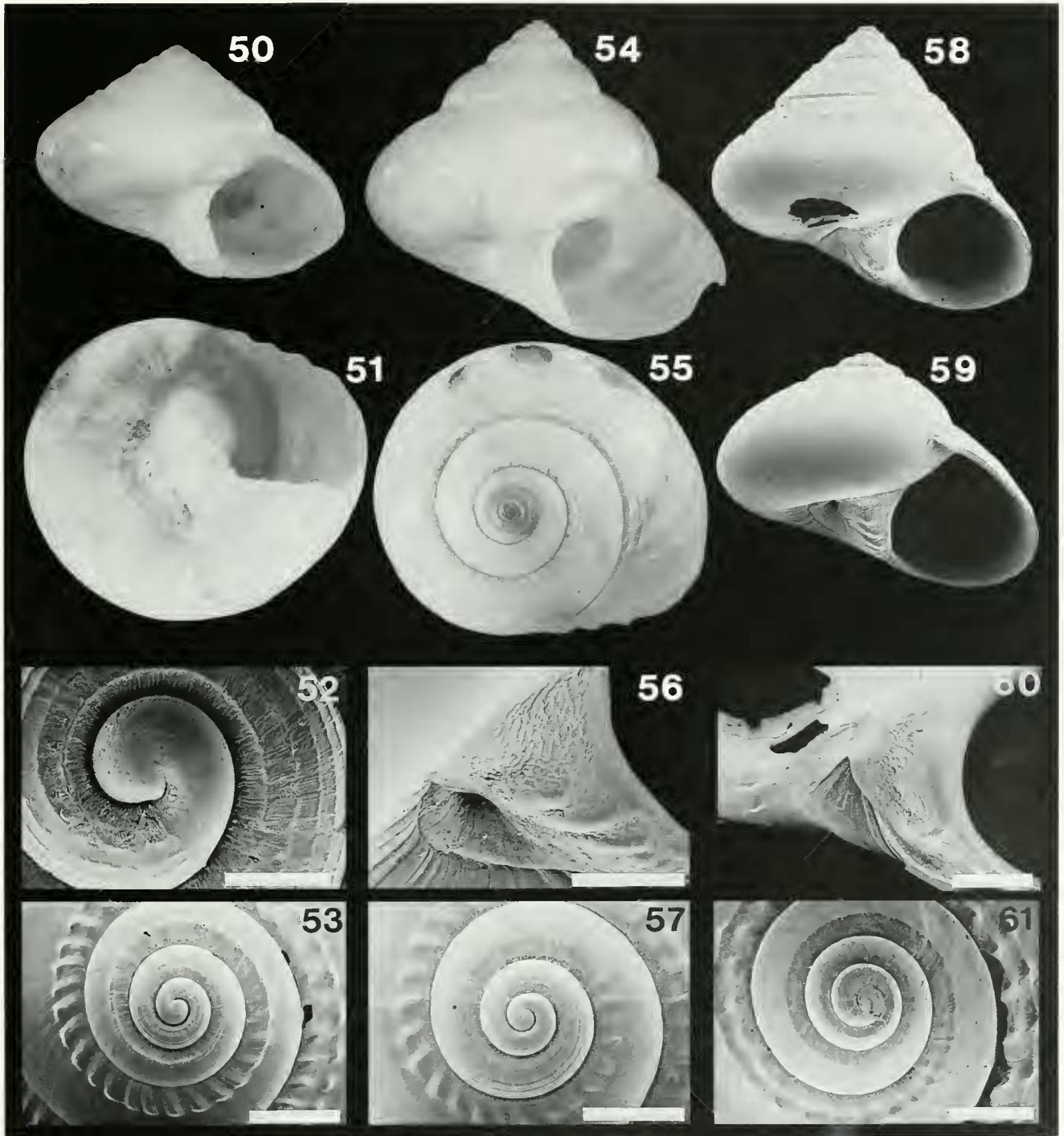
Type material: Holotype NMNZ M.131564 and 29 paratypes (28 NMNZ M.131512, 1 AMS), from type locality, 24 June 1978, R/V *Tangaroa*, collected alive. Paratypes (15 NMNZ): Middlesex Bank, NW of Three Kings Islands, 33°57.0'S, 171°45.4'E, 98–103 m, 31 January 1981, R/V *Tangaroa* (3, M.131508); Middlesex Bank, 33°59.9'S, 171°45.3'E, 186–196 m, 31 January 1981, R/V *Tangaroa* (8, M.131507); Middlesex Bank, 34°01.4'S, 171°45.2'E, 201–216 m, 31 January 1981, R/V *Tangaroa* (1, M.131510); Middlesex Bank, 34°02.1'S, 171°45.8'E, 221–206 m, 31 January 1981, R/V *Tangaroa* (2, M.131511); 37 km NW of Great Island, Three Kings Islands, 34°02.0'S, 171°48.4'E, 188 m, 27 June 1978, R/V *Tangaroa* (1, M.131509).

Type locality: NW of Cape Reinga, 34°14.2'S, 172°32.4'E, 100 m.

Other material examined (34 specimens NMNZ): King Bank, N of Three Kings Islands, 33°57.4'S, 172°19.4'E, 128–123 m, 1 February 1981, R/V *Tangaroa* (5, M.72047); 37 km NE of Great Island, Three Kings Islands, 33°58.0'S, 172°30.6'E, 550 m, 25 June 1978, R/V *Tangaroa* (3, M.93904); Middlesex Bank, NW of Three Kings Islands, 34°01.2'S, 171°44.4'E, 206–211 m, 31 January 1981, R/V *Tangaroa* (2, M.131506); Middlesex Bank, 34°02.0'S, 171°44.0'E, 246–291 m, 31 January 1981, R/V *Tangaroa* (14, M.131505); 22 km ENE of Great Island, 34°05.0'S, 172°24.6'E, 200 m, 24 June 1978, R/V *Tangaroa* (8, M.93456); off Three Kings Islands, 34°10'S, 172°12'E, 252 m, 19 February 1974, R/V *Acheron* (1, M.34020); NW of Cape Reinga, 34°22.8'S, 172°24.6'E, 121 m, 2 February 1981, R/V *Tangaroa* (1, M.131503).

Distribution (Figure 48): Off Three Kings Islands and off Cape Reinga, 98–550 m, collected alive at 100 m on comminuted bryozoan/shell substratum with sponges, corals, hydroids, etc.

Remarks: Compared with *Solariella tryphenensis* and *S. peristicta*, which it resembles in shape, *S. flavida* differs principally in having finer primary spiral cords on



Figures 50–61. Shells of species of *Bathymophila*. **50–53.** *B. gravida* new species **50, 51.** Holotype, N Three Kings Rise, 1137–1150 m, NZOI H680 (9.50 × 12.6 mm). **52, 53.** Paratype, N Three Kings Rise, 1216–1385 m, NZOI P1123 (10.0 × 13.4 mm). **54, 55.** *B. sp. cf. gravida* new species, N Three Kings Rise, 1216–1385 m, NZOI U602 (12.0 × 13.0 mm). **56, 57, 59.** *B. callomphala* (Schepman), paralectotype, Sulu Sea, 450 m, ZMA 3.08.050 (4.60 × 6.50 mm). **58, 60, 61.** *B. valentia* new species, holotype, N Three Kings Rise, 1570–1563 m, NZOI 11681 (7.40 × 8.50 mm). Scale 52 = 250 μm, others = 1 mm.

the spire (8 or 9, cf. 5–8 and 6, respectively, on penultimate whorl in adults) and in having a yellow color pattern. *S. flavida* and *S. peristicta* have been taken together as empty shells at five stations, suggesting that they

live in close proximity to one another, if not sympatrically.

Etymology: Yellowish (Latin).

Genus *Bathymophila* Dall, 1881

Bathymophila Dall, 1881: 102. Type species (by monotypy): *Margarita (Bathymophila) euspira* Dall, 1881; Recent, Atlantic.

Ethaliopsis Schepman, 1908: 51. Type species (by monotypy): *Solariella (Ethaliopsis) callomphala* Schepman, 1908; Recent, Indonesia.

Remarks: The radula of the type species of *Bathymophila* is unknown, and *Bathymophila* has traditionally been referred to Margaritinae because the shell bears a general resemblance to species of *Margarites* Gray, 1847 (Quinn, 1979). The type species of *Bathymophila* and *B. bairdi* (Dall, 1889) (Quinn, 1979, figs. 1–4) are closely similar to *Ethaliopsis callomphala* (Schepman, 1908) (figures 56, 57, 59) in gross shell facies. All three are distinctive in having spiral sculpture on the earliest teleoconch whorls, subsequent teleoconch whorls smooth apart from (usually) a subsutural row of nodules, and the umbilicus filled by a heavy callus with a granular surface and a small nodule near the abapical extremity. *Bathymophila gravida* new species appears to have exceptionally variable shell morphology and to encompass within its variation forms that are scarcely distinguishable from *B. euspira* or *B. bairdi* in gross morphology. The radula of *B. gravida* new species (figures 130, 131) is essentially similar to that of *E. callomphala* (Schepman, 1908, pl. 9, fig. 9) but is distinctive in having a flagellum-like projection on the lateromarginal plate. *Ethaliopsis* is here treated as a synonym of *Bathymophila*, because there seems to be no way of justifying continued separation. The *Bathymophila* radula is strongly similar to those of the type species of *Microgaza* (Marshall, 1979, fig. 9J–L) and *Archiminolia* (Herbert, 1987, fig. 209) but differs in that the lateromarginal plate is narrower and has a terminal flagellum-like projection.

The animal of a paralectotype of *B. callomphala* has unpigmented eyes (blind). On the right side is a rounded neck lobe, from which the eye stalk is not differentiated; and three epipodial tentacles, the anterior one broad with a rounded tip and projecting posteriorly from a broad membrane; middle tentacle posterior to a convoluted membrane, smallest; posterior tentacle long and slender. Left side with very small eye stalk, two small, tapered neck lobes, and three large epipodial tentacles, the anterior one separated from the posterior two by a broad epipodial lobe. The animals of the three other *Bathymophila* species examined (see below) are essentially similar, having a broad right neck lobe, two smaller left neck lobes, three well-developed pairs of epipodial tentacles, and a broad epipodial lobe between the two anterior pairs of tentacles.

There is rather smooth transition in shell morphology between *Bathymophila* species and the type species of *Archiminolia* among representatives from the New Zealand region. For example, *Archiminolia alabida* (Marshall, 1979, fig. 9K) and *A. tenuiseptum* new species, and *A. diademata* new species have the umbilicus covered by an extremely thin callus with a granular surface and a thin callus lip as in *Bathymophila euspira*, yet

the covering is a thin, smooth, translucent septum rather than thick pad with a granular surface, and the shell is otherwise similar to the type species of *Archiminolia*. On the other hand, some apparent forms of *Bathymophila gravida* have an open umbilicus at maturity and are thus extremely similar to *Archiminolia* species. Whereas there seems little doubt that *Ethaliopsis* is a synonym of *Bathymophila* and that *Bathymophila* and *Archiminolia* are closely related to *Microgaza*, I hesitate to suggest that *Archiminolia* is a synonym of *Bathymophila* or *Microgaza* or that *Bathymophila* and *Archiminolia* might be more appropriate as subgenera of *Microgaza*. Because of these uncertainties, I accept *Bathymophila*, *Microgaza*, and *Archiminolia* as discrete genera, defined as follows: *Bathymophila*—high to low spire, narrow umbilicus infilled by heavy callus with granular structure and with one or two small bosses near base, some species with fine interstitial axial riblets on early teleoconch, lateromarginal plate (innermost marginal) with terminal flagellum; *Microgaza*—low spire, umbilicus open and very wide, externally bounded by rounded axial folds separated by incised grooves, no interstitial axial riblets on early teleoconch, lateromarginal plate broad and simple; *Archiminolia*—high to moderate spire, narrow umbilicus open or covered by a thin septum, no interstitial axial riblets on early teleoconch though fold-like axial costae present in some species, lateromarginal plate broad and lacking terminal flagellum.

Microgaza, *Bathymophila*, and *Archiminolia* species are strikingly similar to *Solariella nuda* (Dall, 1896) (Hickman and McLean, 1990, fig. 72A, 75B), the smoother forms of *S. obscura* (Couthouy, 1838) (Warén, 1993, fig. 5, 7), and some species of *Ilanga* Herbert, 1987 (Herbert, 1987) in shell morphology, the radulae of which, however, lack lateromarginal plates (see remarks on *Solariella*).

Besides the species discussed herein, the only other known members of *Bathymophila* are *Solariella micans* Dautzenberg and Fischer, 1896 (Warén, 1990, p. 180), from the northeastern Atlantic, and an undescribed western Atlantic species (J.F. Quinn, pers. comm.).

Bathymophila gravida new species
(Figures 50–53, 75, 130, 131)

Description: Shell up to 16 mm wide, wider than high, rather thick and heavy, polished, white, umbilicus filled by thick callus. Protoconch 430 μ m wide, sculptured with a few fine spiral threads, tip of apical fold broadly rounded. Teleoconch up to 5.3 whorls; first whorl convex, subsequent whorls weakly convex on spire and base, periphery evenly rounded, second and third whorls with narrow horizontal sutural ramp with angulate rim. Spire on first 1.0–2.5 whorls sculptured with fine, similar spiral cords, and much finer, crowded interstitial axial riblets. 7 cords on first whorl, typically multiplying to 8–10 by intercalation, all spirals other than that at ramp rim weakening and vanishing together with riblets. On third whorl ramp rim spiral enlarging to

occupy position of former sutural ramp, with rounded nodules, cord splitting to form 2 similar cords with rounded nodules, nodules obsolete on last adult whorl. Base beside umbilical callus typically with 1 or 2 low or obsolete spiral cords with rounded nodules, nodules discrete or continuous across interspace. Umbilicus rather narrow with tightly rounded rim, outer part completely covered by thick callus with finely granulate surface, small rounded boss near abapical extremity. Aperture subcircular, outer lip thin at rim, moderately thickened within, simple, inner lip continuous with umbilical callus. Animal (alcohol, form C, NZOI U602) lacking eye pigment. Right side with flap-like neck lobe fused to eye-stalk, and 3 long, slender epipodial tentacles, anterior tentacle separated from posterior 2 by broad epipodial lobe. Left side with 2 small, tapered neck lobes and 4 epipodial tentacles, anterior tentacle longest and narrowly tapered, second tentacle very small, posterior tentacles of intermediate size, second tentacle extending from edge of broad epipodial lobe between first and third tentacles. Radula (holotype, figures 130, 131) with 9 pairs of marginal teeth per transverse row, central and lateral teeth with strongly serrate cutting areas, innermost marginal with flagellum-like terminal cusp on outer edge.

Type material: Holotype H680 and 5 paratypes NZOI P1127, from type locality, 6 February 1988, R/V *Rapuhia* (U584), collected alive. Paratypes (10): N Three Kings Rise, 31°19.9'S, 173°05.1'E, 1570–1563 m, 9 February 1988, R/V *Rapuhia* (1, NMNZ M.131565; 5, NZOI U601/P1128); N Three Kings Rise, 31°30.7'S, 172°49.8'E, 1216–1385 m, 9 February 1988, R/V *Rapuhia* (2, NMNZ M.131566; 2, NZOI U602/P1123)

Type locality: N Three Kings Rise, 31°26.3'S, 172°35.6'E, 1137–1150 m.

Other material examined (25 specimens): N Three Kings Rise, 30°21.5'S, 173°08.7'E, 1474–1365 m, 7 February 1988, R/V *Rapuhia* (1 form B, NZOI U595); N Three Kings Rise, 30°32.3'S, 172°55.3'E, 1097–1082 m, 7 February 1988, R/V *Rapuhia* (2 form A, NZOI U593); N Three Kings Rise, 30°40.9'S, 173°51.5'E, 1335–1520 m, 8 February 1988, R/V *Rapuhia* (1 form A, NZOI U598); N Three Kings Rise, 31°19.9'S, 173°05.1'E, 1570–1563 m, 9 February 1988, R/V *Rapuhia* (4 form B, 8 form C, 4 form D, NZOI U601); N Three Kings Rise, 31°30.7'S, 172°49.8'E, collected alive, 1216–1385 m, 9 February 1988, R/V *Rapuhia* (1 form C, NZOI U602); S Norfolk Ridge, 34°44.1'S, 169°25.0'E, 1123–1064 m, 3 February 1988, R/V *Rapuhia* (4 form A, NZOI U571).

Distribution (Figure 75): Southern Norfolk Ridge and northern Three Kings Rise, 1082–1570 m, collected alive at 1137–1150 m (form A) and 1216–1385 m (form C) from rocky substrata with foraminiferal sand.

Remarks: *Bathymophila gravida* differs from the lectotype (the specimen figured by Schepman here selected, ZMA 3.08.049, *Siboga* station 100, Sulu Sea, 450 m)

and paralectotypes of *B. callomphala* (Schepman, 1908) principally in attaining much larger size (maximum width 16 mm, cf. 6.50 mm), and in having a smaller protoconch (width 350 μ m, cf. 430 μ m). The shell of a paralectotype of *B. callomphala* is illustrated here (figures 56, 57, 59), and some features of the external anatomy are described above.

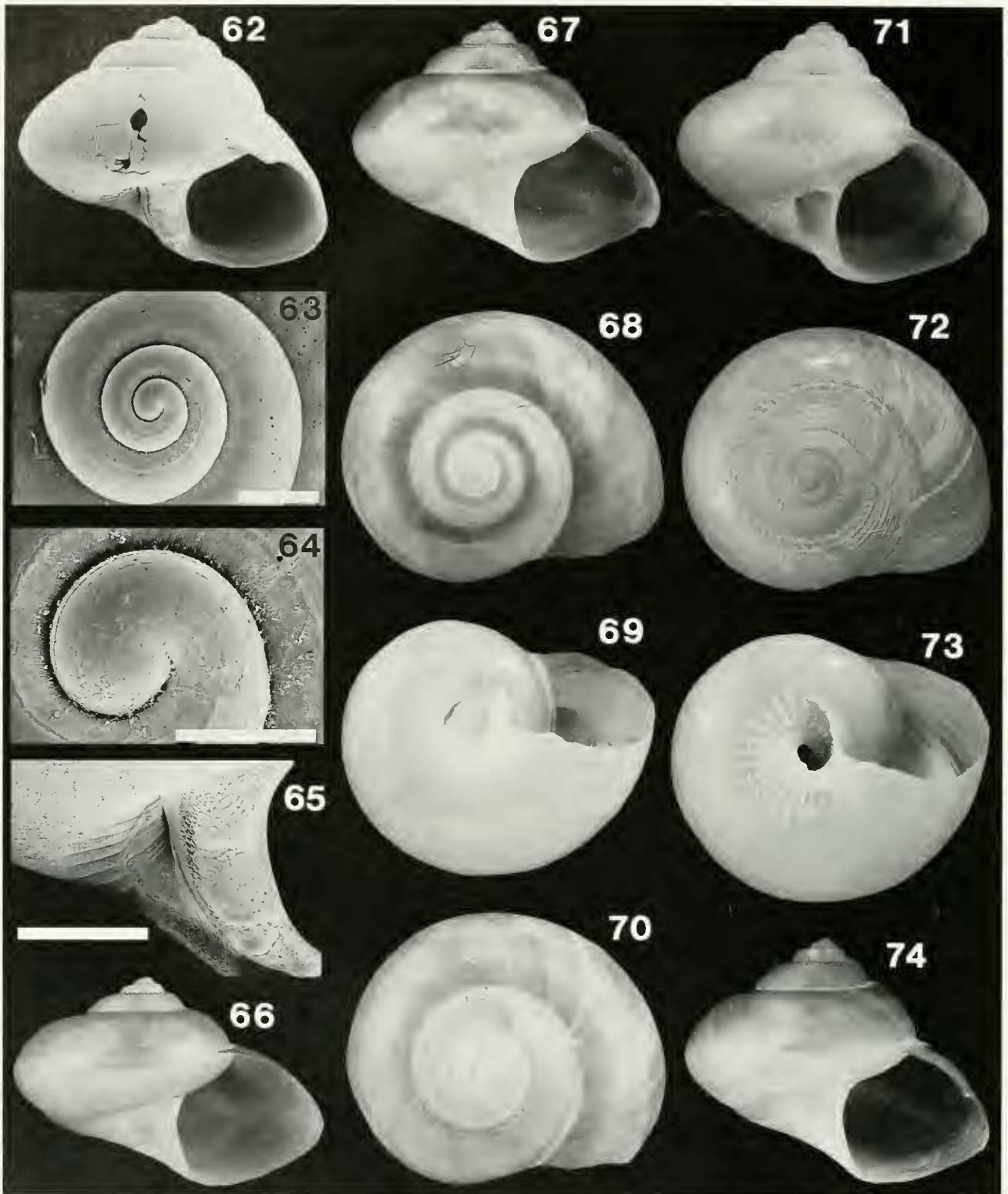
Four shell morphotypes are present in the sample from NZOI station U601: form A (7 specimens, figures 50–53, includes type material)—width up to 16 mm (est.), length/width ratio 0.72–0.88 (4 specimens), weakly convex spire whorls, two nodular subsutural spirals, one or two rows of nodules on inner base, smooth periphery, umbilicus infilled; form B (4 specimens, figures 54, 55) width up to 12 mm (est.), length/width ratio 0.88 (1 specimen), 1 nodular subsutural spiral, inner base smooth or with weak axially elongate nodules, periphery smooth, umbilicus infilled; form C (8 specimens)—width up to 12 mm, length/width ratio 0.82–0.92 (2 specimens), no subsutural or basal spirals or nodules, smooth periphery, umbilicus infilled in six specimens, open in two; form D (4 specimens)—width 14 mm, length/width ratio 0.86 (1 specimen), no subsutural or basal spirals or nodules, smooth periphery, umbilicus open, early teleoconch spirals also more persistent than in other forms. All other samples examined are form A shells with the exception of NZOI station U602, which comprises four form A and one form C with an infilled umbilicus. The single shell from station U595 resembles form B but has no nodules on the subsutural spiral. The single shell from station U598 has no spiral cord or nodules on the base but otherwise resembles form A.

Given the occurrence of additional variants at NZOI stations U602 and U598, and reports of similar variation in *B. cuspira* (Dall, 1881) by Jeffreys (1883) and Quinn (1979), I am not convinced that forms A–C represent distinct species. The status of form D is even less clear. Assuming that all specimens really are conspecific, extreme polymorphism may be due to one or more of several factors such as sexual dimorphism, influx of genetic material over time from remote sources, translocation from various depths, or differential Mavrian founder effect on waxing and waning spatially and temporarily isolated populations. Most of the shells are old and friable to varying degrees and may have accumulated in self-buffering calcareous sediments over hundreds or thousands of years. Form A, and forms B and C are strikingly similar respectively to *B. bairdi* (Dall, 1889), which is particularly variable in sculpture, and *B. cuspira*, both of which have been collected in the Yucatan Channel at 1170 meters depth (Quinn, 1979), the implication being that the latter two may likewise be forms of a single species.

Etymology: Laden, heavy (Latin).

Bathymophila valentia new species
(Figures 58, 60, 61, 75)

Description: Shell up to 8.60 mm wide, wider than high, rather thick and heavy, polished, white, umbilicus



Figures 62–74. Shells of species of *Bathymophila* and *Archiminolia*. **62–65.** *B. asphala* new species, holotype, Wanganella Bank, Norfolk Ridge, 449–442 m, NZOI H682 (4.20 × 5.15 mm). **66–70.** *A. tenuiseptum* new species, N Three Kings Rise, 790–780 m. **66, 68, 69.** Holotype, NZOI H683 (11.0 × 16.7 mm). **67, 70.** Paratype, NZOI P1124 (11.2 × 17.0 mm). **71–73.** *A. diadema* new species, holotype, Wanganella Bank, Norfolk Ridge, 757–660 m, NZOI 11684 (10.0 × 12.3 mm). **74.** *A. alabida* (Marshall), holotype, Silent 1 seamount, Kermadec Ridge, 695–689 m, NZOI H255 (8.30 × 10.5 mm). Scales 63, 65 = 1 mm. 64 = 250 μ m.

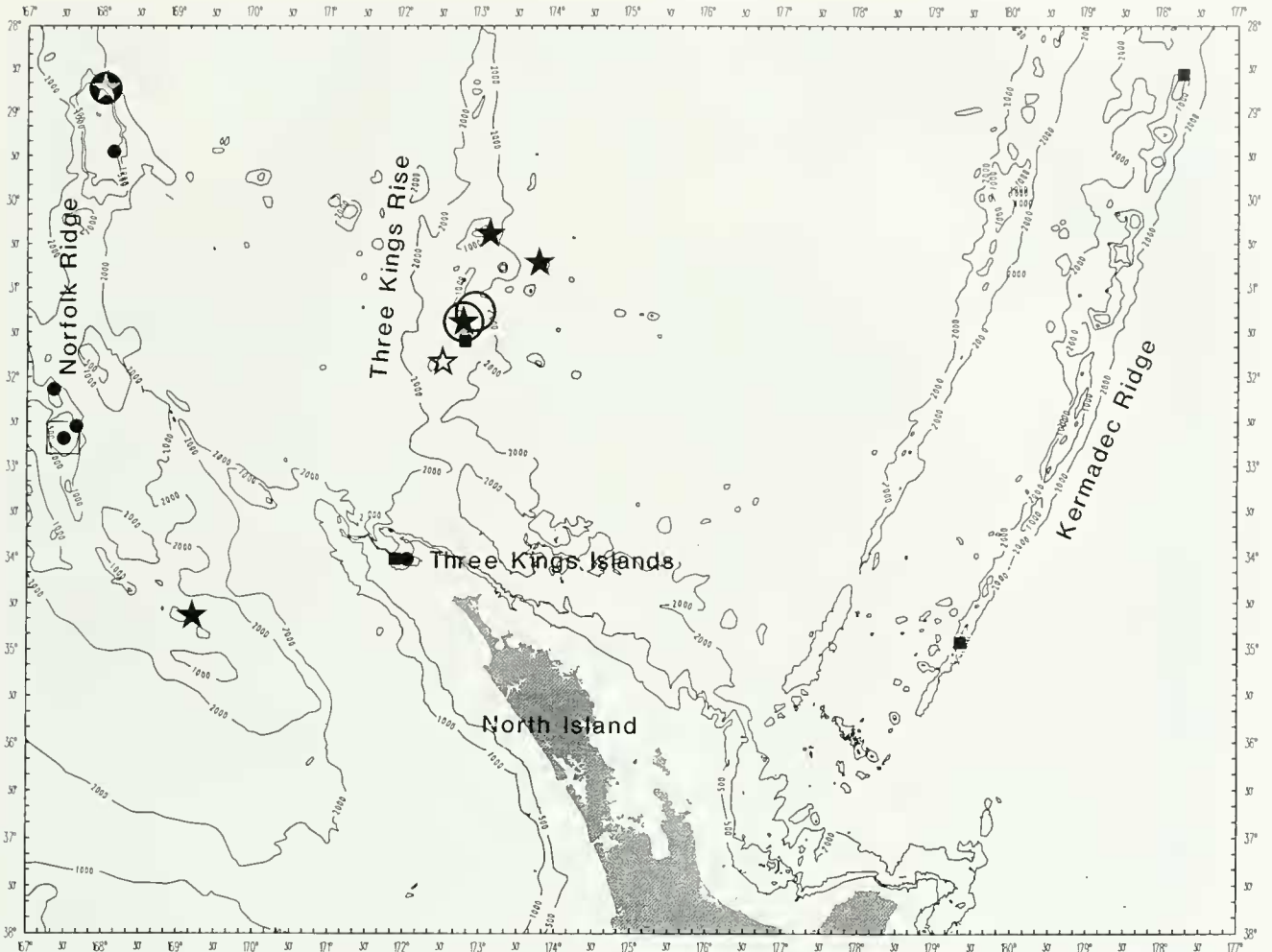


Figure 75. Map of northern New Zealand region showing distribution of species of *Bathymophila*, *Archiminolia*, and *Microgaza* (500, 1000 and 2000 m isobaths indicated): *B. gravida* new species (★), *B. valentia* new species (○), *A. alabida* (Marshall) (■), *B. asphala* new species (●), *A. tenuiseptum* new species (☆), *A. diadema* new species (□), *M. norfolkensis* new species (★).

filled by thick callus. Protoconch 430 μm wide, sculpture unknown (surface etched), tip of apical fold broadly rounded. Teleoconch up to 4.8 whorls; first whorl strongly convex with narrow, horizontal sutural ramp; subsequent whorls becoming almost flat on spire; low suprasutural angulation commencing after second whorl, angulation vanishing on penultimate or last whorl in adults so that adult periphery is rounded, base weakly convex. First whorl sculptured with 2 or 3 fine, similar spiral threads, 1 on ramp, 1 on ramp rim, another beside ramp rim in 1 specimen, crisp on first whorl, obscure on second whorl; on third whorl resolving as 2 low, broad, rounded, subsutural spiral cords, eventually with rounded nodules; periphery on last adult whorl with 3 or 4 obscure or well-defined, narrow, smooth, rounded spiral cords, 1 surmounting suprasutural angulation, in some specimens another on its adapical side, 2 on outer base; base with or without row of rounded nodules at inner third, broad, smooth, rounded swelling beside umbilical rim. Umbilicus narrow though completely covered by

thick callus with coarsely granulate surface, strong rounded, spirally elongate boss near abapical extremity. Aperture subcircular, outer lip thin at rim, moderately thickened within, simple, inner lip continuous with umbilical callus. Animal unknown.

Type material: Holotype NZOI H681 and 2 paratypes (1, NMNZ M.131611; 1 NZOI P1129), from type locality, 9 February 1988, R/V *Rapuhia* (U601). Paratype (1): N Three Kings Rise, 31°30.7'S, 172°49.8'E, 1216–1385 m, 9 February 1988, R/V *Rapuhia* (NZOI U602/P1130).

Type locality: N Three Kings Rise, 31°19.9'S, 173°05.1'E, 1570–1563 m.

Distribution (Figure 75): Northern Three Kings Rise, 1216–1570 m (dead).

Remarks: *Bathymophila valentia* closely resembles *B. gravida* in gross facies, differing in attaining smaller size and in being smaller relative to the number of whorls

(width up to 8.60 mm, 4.8 TW, cf. 16.0 mm, 5.3 TW) and in having a strong, rounded spiral swelling beside the umbilical rim. *Bathymophila valentia* occurred together with *B. gravida* (all empty shells) at the two stations from which it is known, and there is no indication of intergradation.

Etymology: Strength, vigor, value (Latin).

Bathymophila asphala new species
(Figures 62–65, 75)

Description: Shell up to 8.2 (est.) mm wide, wider than high, rather thick and heavy, polished, white, umbilicus filled by thick callus. Protoconch 350 μ m wide, sculptured with 5 crisp, similar spiral threads, tip of apical fold broadly rounded. Teleoconch up to 4.75 whorls, first 1.5 whorls strongly convex, subsequent whorls broadly convex above and below strongly rounded periphery, suture channelled before last adult whorl. Spire on first 1.5 whorls sculptured with fine, similar spiral threads, typically multiplying by intercalation, weakening and vanishing on next half whorl. Subsequent whorls essentially smooth apart from subsutural row of low, rounded nodules on third and first half of fourth whorl; and moderate to weak, rounded axial pleats on inner third of base, umbilicus bounded by low, rounded swelling. Umbilicus rather narrow with tightly rounded rim, partly or completely covered by thick callus with finely granulate surface, 2 rounded, spirally elongate bosses near abapical extremity, another near adapical extremity. Aperture subcircular, outer lip thin at rim, moderately thickened within, simple, inner lip continuous with umbilical callus. Animal unknown.

Type material: Holotype NZOI H682 and 9 paratypes (1, NMNZ M.131612; 8, NZOI P1131), from type locality, 25 January 1977, R/V *Tangaroa* (P13). Paratype (1): Wanganella Bank, Norfolk Ridge, 32°40.8'S, 167°26.8'E, 757–660 m, 25 January 1977, R/V *Tangaroa* (NZOI PS/P1132).

Type locality: Wanganella Bank, Norfolk Ridge, 32°10.5'S, 167°21.2'E, 449–442 m.

Other material examined: SSE of Philip Island, Norfolk Island, 29°33'S, 168°07'E, 326 m, 11 July 1962, R.N.Z.F.A. *Tui* (4 juveniles, NMNZ M.224838); Wanganella Bank, Norfolk Ridge, E slope, 32°35.3'S, 167°41.8'E, 437–422 m, 29 January 1981, R/V *Tangaroa* (3 juveniles, NMNZ M.234119); N of Three Kings Islands, 34°01'S 172°07'E, 622 m, 18 February 1974, R/V *Acheron* fragment of adult, NMNZ M.34608).

Distribution (Figure 75): Norfolk Island, Wanganella Bank and off Three Kings Islands, 326–757 m (dead).

Remarks: *Bathymophila asphala* differs from *B. gravida* in attaining smaller size (width up to ca. 8.2 mm, cf. 16 mm), in having a smaller protoconch (width 350 μ m, cf. 430 μ m), and in having two bosses instead of one near the base of the umbilical callus. Though very

incomplete, the shell from off the Three Kings Islands resembles the type material in protoconch size and sculpture of the umbilical callus.

Etymology: Steadfast (Greek).

Genus *Archiminolia* Iredale, 1929

Archiminolia Iredale, 1929: 170. Type species (by original designation): *Monilca oleacea* Hedley and Petterd, 1906; Recent, eastern Australia.

Remarks: As discussed above, *Archiminolia* species resemble species of *Bathymophila* and *Microgaza* in gross shell and radular morphology, differing from *Bathymophila* species in that the umbilicus is open or covered by a thin septum at maturity, in having a broad lateromarginal radular teeth without a terminal flagellum, and in having the rim of the inner lip smooth rather than granulate. They differ from *Microgaza* species in having a narrower umbilicus and a higher spire. The animal of the type species has a large left neck lobe and three large, tapered epipodial tentacles on the left side, a broad epipodial lobe between the bases of the two anterior tentacles, and a small flap in front of the anterior tentacle. On the right side are two small, tapered neck lobes, and four long, tapered epipodial tentacles. The radula of the type species was illustrated by Herbert (1987, fig. 209).

Apart from *A. oleacea* (Hedley and Petterd, 1906) and the species recorded below, other species apparently referable to *Archiminolia* include *Solariella zacalles* Melvill and Standen, 1903 (Persian Gulf); *Solariella olivaceostrigata* Schepman, 1908 and *Solariella zacalloides* Schepman, 1908 (Indonesia); and the southern Japanese species *Microgaza fulgens*, Dall, 1907, *Ethaliopsis iridescens* Habe, 1961, *Ethaliopsis katoi* Kuroda and Habe in Habe, 1961, *Microgaza ziczac* Kuroda and Habe in Kuroda, Habe and Oyama, 1971, and *Solariella (Microgaza) opalina* Shikama and Hayashi in Shikama, 1977. Their animals, however, are unknown, and some may prove to belong in *Hanga* Herbert, 1987.

Archiminolia alabida (Marshall, 1979)
(Figure 74)

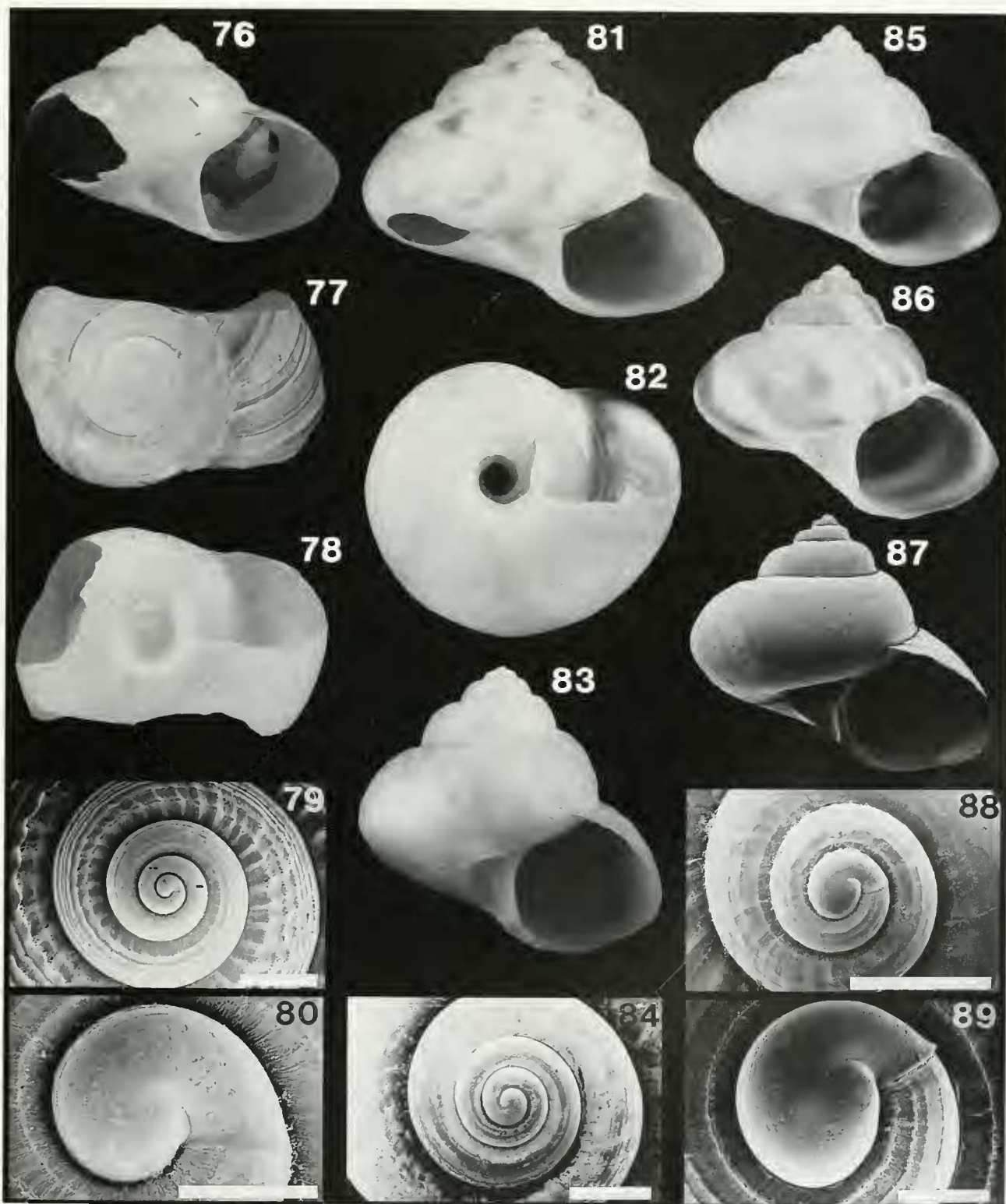
Solariella (Microgaza) alabida Marshall, 1979: 532, fig. 4K–M, 9M–O.

?*Solariella (Microgaza)* sp. cf. *alabida*.—Marshall, 1979: 533, fig. 5A–C.

Type material: Holotype NZOI H255, from type locality, 5 September 1974, R/V *Tangaroa* (J659), collected alive. Paratypes (2): Silent 1 seamount, 35°02.0'S, 179°15.8'E, 803–788 m, 5 September 1974, R/V *Tangaroa* (J660: 1, NMNZ M.131540; 1, NZOI).

Type locality: Silent 1 Seamount, southern Kermadec Ridge, 35°00.6'S, 179°15.1'E, 695–689 m.

Other material examined (3 specimens): N Three Kings Rise, 31°30.7'S, 172°49.8'E, 1216–1385 m, 9 Feb-



Figures 76–89. Shells of species of *Archiminolia*. **76–80.** *A. diadema* new species, paratypes, Wanganella Bank, Norfolk Ridge, 757–660 m, NZOI P1125 (76–78, 9.20 × 13.0 mm). **81.** *A. dawsoni* (Marshall), holotype, NE of Raoul Island, Kermadec Islands, 145 m, NZOI H257 (7.40 × 9.20 mm). **82, 85.** *A. olacca* (Hedley and Petterd), N of Fraser Island, Queensland, 229–192m, AMS C.133269 (13.0 × 16.5 mm). **83, 84.** *A. episcopalis* new species **83.** Holotype, SW of Great Island, Three Kings Islands, 427 m, M.131541 (7.50 × 8.20 mm). **84.** Paratype, SW of Great Island, 440 m, M.131546. **86.** *A. hurleyi* (Marshall), holotype, NE of Raoul Island, 145 m, NZOI H256 (9.00 × 11.0 mm). **87–89.** *A. meridiana* (Dell), Taiaroa Canyon, off E Otago, 549 m, M.9055 (97–6.60 × 7.90 mm). Scales 80, 89 = 250 μm; all other figures = 1 mm.

ruary 1988, R/V *Rapuhia* (1, NZOI U602); Three Kings Trough, NW of Three Kings Islands, 34°00'S, 171°55'E, 805 m, 15 July 1962, R.N.Z.F.A. *Tui* (1, NMNZ M.59362); NE of Raoul Island, Kermadec Islands, 28°34.9'S, 177°50.0'W, 508-510 m, 26 July 1974, R/V *Tangaroa* (1, NZOI K828/2).

Distribution (Figure 75): North Three Kings Rise and Kermadec Ridge, 508-1385 m, collected alive at 689-695 m.

Remarks: *Archiminolia alabida* differs from all species of *Archiminolia*, other than two of the new species described below, in that the umbilicus is covered by a thin, translucent septum at maturity. It is transferred from *Solariella* (*Microgaza*) to *Archiminolia* rather than to *Bathymophila* because the septum is thin and smooth instead of thick and more coarsely granulate and because the lateromarginal plates lack a terminal flagellum.

A single broken shell from off Raoul Island, Kermadec Islands (Marshall, 1979, fig. 5A-C), certainly adult, is more strongly sculptured than the type specimens and lacks an umbilical septum but is otherwise similar. They may well be conspecific, because a similar degree of variation is exhibited by some other *Archiminolia* species.

Archiminolia tenuiseptum new species
(Figures 66-70, 75, 132)

Description: Shell up to 17 mm wide, wider than high, rather thin, highly polished and slippery, umbilicus covered by thin septum. Protoconch and first 2.5 teleoconch whorls translucent white; subsequent spire whorls pink with irregular darker axial bands and a narrow, white suprasutural band; base white, nacreous through translucent outer shell layer, inner lip and umbilical septum white. Protoconch 430-450 μm wide, sculptured with 2 fine, crisp spiral threads and minute granules, tip of apical fold broadly rounded. Teleoconch up to 5 convex whorls, suture channelled on first 3.5 whorls, channel rim angulate, periphery strongly convex, base weakly convex. Spire sculptured with spiral threads and rounded collabral axial folds. Spiral threads on first 3 spire whorls 6, weak or very weak, either vanishing early on fourth whorl or enlarging on third whorl, multiplying by intercalation and persisting throughout. Axial folds strongest abapically and coronating suture, gradually resolving on second or third whorl, weakening on fourth whorl and vanishing early or late on fifth whorl, entirely traversing spire on second and third whorl or third and most of fourth whorl, thereafter increasingly evanescent abapically until restricted to subsutural zone. Base at inner third with 6-8 weak spiral threads and low, rounded axial folds, elsewhere smooth apart from obscure spiral lines. Umbilicus rather narrow with tightly rounded rim, almost or entirely covered by thin translucent septum that spreads from inner lip; inner lip rim with finely granulate surface. Aperture subcircular, outer lip thin at rim, weakly thickened within, simple. Animal with pigmented eyes. Right side with broad neck lobe that is

almost completely fused with eye stalk and extends to a projecting flap at the base of anterior epipodial tentacle, and 3 long, narrowly tapered epipodial tentacles, anterior 2 separated by a broad epipodial lobe. Left side with 2 small neck lobes and 3 posteriorly enlarging epipodial tentacles, bases of posterior neck lobe and anterior 2 epipodial tentacles connected by a broad membrane. Jaw plates thin; jaw elements small, strongest at anterior edge, weakening posteriorly, extending almost to posterior margin though extremely weak in posterior third. Radula typical of the genus (figure 132).

Type material: Holotype NZOI H683 and 1 paratype NZOI P1124, from type locality, 5 February 1988, R/V *Rapuhia* (U582), collected alive.

Type location: N Three Kings Rise, 31°51.7'S, 172°26.0'E, collected alive, 790-780 m.

Distribution (Figure 75): Northern Three Kings Rise, living at 780-790 m.

Remarks: *Archiminolia tenuiseptum* resembles *Archiminolia alabida* in general facies, differing in attaining larger size and in being larger relative to the number of whorls (width up to 17 mm: 5 TW, cf. 10.7 mm: 5 TW) and in having a slightly larger protoconch (width 430-450 μm , cf. 400-420 μm). *Archiminolia tenuiseptum* differs further in having a lower spire, stronger axial sculpture, and stronger sculpture on the inner base. The paratype has a strong growth scar early on the third teleoconch whorl, and it is unclear whether or not the sculptural differences on subsequent whorls between it and the holotype are due to damage to the mantle.

Etymology: Thin-walled (Latin), alluding to the umbilical septum.

Archiminolia diadema new species
(Figures 71-73, 75)

Description: Shell up to 13.5 mm wide, wider than high, rather thin, highly polished, narrow umbilicus open or covered by thin septum. Protoconch and first 3 teleoconch whorls translucent white; subsequent spire whorls pale pink with or without irregular darker axial bands and narrow, white suprasutural band; base white, nacreous through translucent outer shell layer, inner lip and umbilical septum white. Protoconch 370 μm wide, sculptured with 4 or 5 fine, crisp spiral threads, tip of apical fold broadly rounded. Teleoconch up to 5.2 whorls, all but last adult whorl with narrow, more or less horizontal sutural ramp with angulate rim, periphery and early spire whorls strongly convex, last few whorls in adults weakly convex above and below periphery. Spire sculptured with narrow but prominent spiral cords and weak, rounded collabral axial folds. Spiral cords multiplying by intercalation, 7 or 8 at end of third whorl and 9-13 at end of fourth whorl on spire, gradually weakening on mid fourth or early fifth whorl before becoming obsolete; adapical spiral at ramp rim, with prominent,

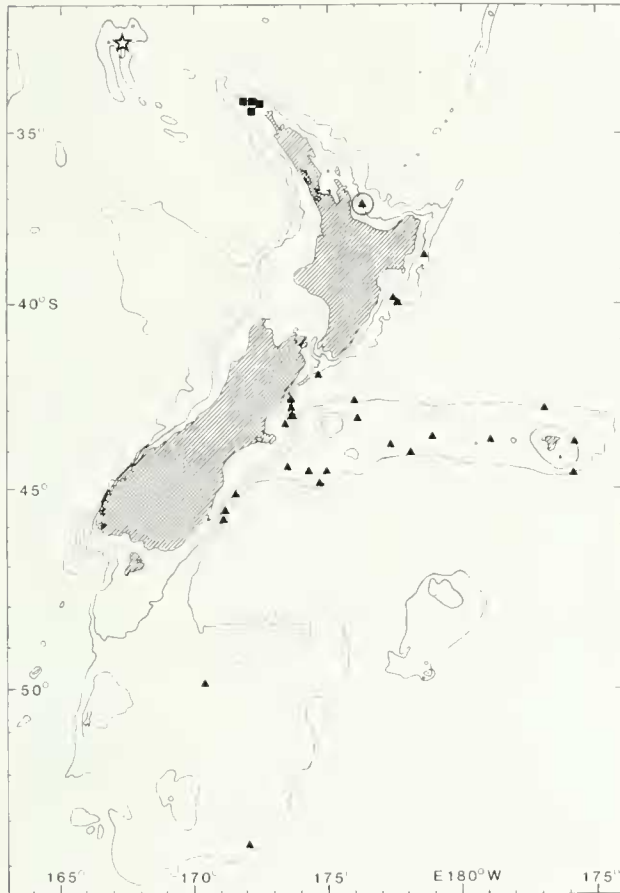


Figure 90. Map of New Zealand region showing distribution of species of *Archiminolia* (200 and 1000 m isobaths indicated): *A. wanganellica* new species (★), *A. episcopalis* new species and *A. regalis* new species (■), *A. meridiana* (Dell) (▲), and *A. diplax* new species (○).

roundly conical nodules after second whorl. Axial sculpture weak before third whorl, becoming obsolete on last adult whorl, strongest at ramp rim, weakening and vanishing abapically across spire whorls. Base with 4 or 5 rounded spiral cords at inner third, and strong, rounded axial folds, elsewhere smooth apart from obscure spiral lines. Umbilicus rather narrow with tightly rounded rim, open in juveniles, in adults open or entirely covered by thin translucent septum that spreads from inner lip, inner lip rim with finely granulate surface. Aperture sub-circular, outer lip thin at rim, weakly thickened within, simple. Animal unknown (only available specimen decayed and broken into pieces during extraction).

Type material: Holotype NZOI H684 and 7 paratypes (2, NMNZ M.272597; 5, NZOI P1125), from type locality, 25 January 1977, R/V *Tangaroa* (NZOI P8), collected alive.

Type locality: Wanganella Bank, Norfolk Ridge, 32°40.8'S, 167°26.8'E, 757–660 m.

Distribution (Figure 75): Wanganella Bank, southern Norfolk Ridge, living at 660–757 m.

Remarks: *Archiminolia diadema* most closely resembles *A. alabida* and *A. tenuiseptum* in general facies. It differs from *A. tenuiseptum* and resembles *A. alabida* in size relative to the number of whorls and differs from both in having a slightly smaller protoconch (width 370 μm , cf. 430–450 μm and 400–420 μm), in that the sub-sutural spiral is stronger and distinctly nodular, in that the spiral and axial sculpture at the inner third of the base is much stronger, and in having paler shell coloration.

Etymology: Crown (Greek), an allusion to the strong subsutural row of nodules.

Archiminolia meridiana (Dell, 1953)
(Figures 87–90, 133)

Zeniminolia meridiana Dell, 1953: 42, fig. 1, 2; Dell, 1956: 48; Dell, 1962: 75.

Spectamen meridianum.—Powell, 1976: 84, Powell, 1979: 64.

Type material: Holotype NMNZ M.5666, from type locality, 4 November 1950, R.R.S. *Discovery II*.

Type locality: Chatham Rise, 43°48'S, 178°58'W, 361 m.

Other material examined (Several hundred specimens): NE of Mayor Island, Bay of Plenty, 37°10'S, 176°23.5'E, collected alive, 732 m, 28 February 1957, M.V. *Alert* (1, M.11257); off Gable End Foreland, 38°38.7'S, 178°41.1'E, collected alive, 755–725 m, 21 January 1981, R/V *Tangaroa* (9, M.130095); off Cape Kidnappers, 39°52.8'S, 177°36.5'E, collected alive, 785–882 m, 21 January 1981, R/V *Tangaroa* (7, M.130097); off Cape Kidnappers, 39°58.55'E, 178°14.18'E, collected alive, 900 m, January 1994, F.V. *San Manukau*, coll. M.Friar (4, M.118128); off Cape Kidnappers, 39°59.7'S, 178°08.0'E, collected alive, 665 m, 7 May 1973, R/V *Tangaroa* (1 NZOI stn. G941); SE of Cape Campbell, 41°55.8'S, 174°40.7'E, 434–446m, 14 January 1979, R/V *Tangaroa* (5, M.60378); steep outer slope of Conway Ridge, S of Kaikoura, 42°37.2'S, 173°42.0'E, collected alive, 503 m, 13 January 1979, R/V *Tangaroa* (2, M.59735); NE of Mernoo Bank, W Chatham Rise, 42°38.1'S, 176°16.3'E, 980–1000 m, 11 January 1979, R/V *Tangaroa* (1, M.59581); NE of Mernoo Bank, 42°38.2'S, 176°10.5'E, collected alive, 999–984 m, 11 January 1979, R/V *Tangaroa* (3, M.59721); off Kaikoura, 42°45.2'S, 173°44.8'E, 805 m, 4 November 1979, R/V *Tangaroa* (2 NZOI stn. S213); off Chatham Islands, 42°46.59'S, 177°15.91'W, 987–996 m, 23 July 1994, F.R.V. *Tangaroa* (1, M.130101); off Waiiau River mouth, S of Kaikoura, 42°55'S, 173°43'E, collected alive, 549–586 m, 18 March 1976, R/V *Acheron* (many, M.50870); Mernoo Bank, 42°59.4'S, 175°30.5'E, 112 m, 23 January 1954, M.V. *Alert* (1, M.9128); up steep wall of Pegasus Canyon, NE of Banks Peninsula, 43°14'S, 173°39'E, collected alive, 1006–512 m, 27 September 1976, R/V *Acheron* (9, M.52780); Chatham Rise, 43°14'S, 176°11'E.

collected alive, 366 m, 23 January 1954, M.V. *Alert* (10, M.130102); head of Pegasus Canyon, NE of Banks Peninsula, 43°24'S, 173°26'E, 366–311 m, 18 March 1976, R/V *Acheron* (1, M.51032); Chatham Rise, 43°32'S, 178°38'E, collected alive, ca. 549 m, 24 January 1954, M.V. *Alert* (5, M.130098); NE of Kaingaroa, Chatham Islands, 43°35'S, 176°03.5'W, collected alive, 220–229 m, 7 February 1954, M.V. *Alert* (1, M.130105); Chatham Rise, 43°38'S, 177°19'E, 531 m, 11 February 1954, M.V. *Alert* (1, M.130100); Chatham Rise, 44°04'S, 178°04'W, collected alive, 476 m, 10 February 1954, M.V. *Alert* (5, M.130099); SE of Banks Peninsula, 44°28.0'S, 174°54.8'E, collected alive, 692 m, 5 October 1979, R/V *Tangaroa* (2 NZOI stn. S143); SE of Pitt Island, Chatham Islands, 44°32'S, 176°05'W, 302 m, 3 February 1954, M.V. *Alert* (17, M.130104); SE of Banks Peninsula, 44°33.9'S, 174°51.2'E, collected alive, 750 m, 4 October 1979, R/V *Tangaroa* (5 NZOI stn. S140); SE of Banks Peninsula, 44°35.4'S, 174°49.6'E, collected alive, 785 m, 4 October 1979, R/V *Tangaroa* (13 NZOI stn. S138); SE of Pitt Island, Chatham Islands, 44°35.5'S, 176°04'W, collected alive, 604 m, 3 February 1954, M.V. *Alert* (27, M.130103); SE of Banks Peninsula, 44°50.17'S, 174°31.33'E, collected alive, 760 m, 5 October 1979, R/V *Tangaroa* (8 NZOI stn. S147); head of Waitaki Canyon, off Oamaru, 45°10'S, 171°30'E, 293–256 m, 19 March 1976, R/V *Acheron* (3, M.51295); Karitane Canyon, off East Otago, 45°37.5'S, 171°06.0'E, collected alive, 476–640 m, 28 March 1954, M.V. *Alert* (6, M.9136); head of Karitane Canyon, 45°38.5'S, 171°05.0'E, 585–530 m, 19 March 1976, R/V *Acheron* (1, M.51143); off East Otago, 45°45'S, 171°02'E, 520–600 m, 1980, R/V *Munida* (3, M.100609); Taiaroa Canyon, NE of Otago Peninsula, 45°45.4'S, 171°05'E, collected alive, 549 m, 16 August 1955, M.V. *Alert* (many, M.9055); Taiaroa Canyon, 45°45.6'S, 171°05'E, 549 m, 23 January 1957, M.V. *Alert* (19, M.11256); Papanui Canyon, off Taiaroa Head, 45°46'S, 171°03'E, 660 m, 1 September 1976, R/V *Munida* (19, M.58479); off Otago Peninsula, 45°50.85'S, 171°01.71'E, 555–604 m, 4 June 1992, R/V *Munida* (8, M.131531); off Otago Peninsula, 45°51.05'S, 171°00.90'E, collected alive, 500–589 m, 4 June 1992, R/V *Munida* (2, M.130745); Canyon E, off East Otago, collected alive, 421 m, 27 October 1967, R/V *Munida* (6, M.26292); off Otago Peninsula, 45°51.71'S, 171°01.78'E, collected alive, 619–550 m, 4 June 1992, R/V *Munida* (19, M.130096); between Pukaki Rise and Auckland Islands, 49°50'S, 170°14'E, collected alive, 593 m, 4 September 1975, R/V *Tangaroa* (1 NZOI stn. S16); SE of Campbell Island, 53°32.8'S, 172°16.6'E, collected alive, 580 m, 2 January 1971, R/V *Tangaroa* (1 NZOI stn. G927).

Distribution (Figure 90): North and South Island east coast, from Mayor Island to Otago Peninsula, Chatham Rise and Chatham Islands and off Auckland and Campbell islands, 220–1000 m; collected alive at 220–999 m.

Remarks: The animal (alcohol) has on its right side a well-developed neck lobe extending from the eyestalk to

the base of the first epipodial tentacle, more strongly projecting anteriorly and posteriorly; three long, narrowly tapered epipodial tentacles, and a broad, rounded epipodial lobe between the two anterior tentacles. On the left side are two neck lobes, the anterior slender, the posterior subtriangular, and three long, narrowly tapered epipodial tentacles, between which the epipodial fringe is particularly well developed. The jaw plates are well-developed. Jaw plate elements are strongest at the anterior edge and progressively weaken posteriorly. The radula (figure 133) is typical of the genus.

Following an initial spirally lirated stage, the whorls of *Archiminolia meridiana* may be entirely smooth or have a subsutural zone of rounded axial plicae that eventually weaken and vanish, with or without rounded plicae at the umbilical rim or the addition of a narrow horizontal subsutural ramp with an angulate rim; the spire axials and subsutural ramp become obsolete late on the penultimate whorl or early on the last whorl in adults. The shell may be uniform nacreous white, or the spire on the last one or two whorls may be pale pinkish buff, with or without pale axial bands, the base white below a sharp peripheral boundary. All combinations occur together and completely intergrade in several large samples. Specimens from off North Cape (NMNZ M.131559, 131562, juveniles and fragmentary adults) differ from southern shells in being more deeply pigmented, in consistently lacking subsutural axial plicae, and in having smaller protoconchs (width 470–500 μm , cf. 570–630 μm). It is unclear whether these northern specimens represent a disjunct local population of *A. meridiana* or a distinct species, and better, geographically intermediate material (if such exists) is required.

Archiminolia meridiana is not to be confused with a superficially similar though larger species (width up to 22 mm, cf. 14 mm) with a rounded instead of angulate umbilical rim, which occurs on the Bounty Platform at 705–722 meters depth and is an undescribed species of *Margarites* Gray, 1847 (Margaritinae) (NZOI stations 1684, 1685).

Archiminolia diplax new species
(Figures 90, 92–95)

Description: Shell up to 11.0 mm wide, wider than high, of moderate thickness, stout, polished, narrowly umbilicate, white. Protoconch 600 μm wide, minutely granulate and with 2 fine spiral threads, tip of apical fold broadly rounded. Teleoconch up to 5 (est.) whorls; first whorl strongly convex; subsequent whorls with narrow, sloping sutural ramp with angulate rim and pronounced suprasutural angulation; spire whorls strongly flattened between angulations; both angulations with rounded, axially elongate nodules, angulations and nodules obsolete on last adult whorl; periphery rounded, base weakly convex. First few whorls sculptured with crisp, similar spiral lirae, 7 or 8 on spire, weakening and vanishing at end of second whorl. Inner third of base with rounded axial pleats, 2 low, rounded spiral cords at umbilical rim. First

2 whorls with microsculpture of minute, crisp granules; fine collabral and spiral growth lines throughout. Umbilicus rather narrow, rim tightly rounded, wall weakly convex, with fine collabral growth lines. Aperture sub-circular, outer lip thin at rim, moderately thickened within, simple, inner lip rather strongly thickened against umbilical rim. Radula unknown (only live-taken specimen is juvenile).

Type material: Holotype NMNZ M.60166, from type locality, 23 January 1979, R/V *Tangaroa*. Paratypes (5 juveniles NMNZ), SE of Aldermen Islands, 37°04.3'S, 176°26.6'E, collected alive, 807–872 m, 23 January 1981, R/V *Tangaroa* (M.75065).

Type locality: NE of Mayor Island, 37°09.1'S, 176°24.4'E, 753–826 m.

Other material examined: 1 juvenile NMNZ, E of Great Barrier Island, 36°12.0'S, 176°19.4'E, 486–655 m, 25 January 1981, R/V *Tangaroa* (M.131558).

Distribution (Figure 90): Off Great Barrier, Aldermen, and Mayor islands, 486–872 m, collected alive at 807–872 m from mud.

Remarks: This species is extremely distinctive in having a suprasutural angulation on the spire whorls, rounded, axially elongate nodules on both the submedian and subsutural angulation, and rounded axial pleats on the inner base. The sculpture of the third teleoconch whorl (where sculpture is transitional from juvenile to adult) is unknown, the type material comprising two juvenile paratypes with 1.75 and 1.8 teleoconch whorls, and the adult holotype, the first three whorls of which are decorticated.

Etymology: Double (Greek), an allusion to the two angulations on the spire.

Archiminolia episcopalis new species
(Figures 83, 84, 90)

Description: Shell up to 10.6 mm wide, wider than high, rather thin, polished, narrowly umbilicate. Protoconch and first 2.5 teleoconch whorls white, subsequent whorls pale buff with pale, irregular reddish brown axial bands that extend from suture to extreme periphery or slightly above it, sharply truncated abapically, base white. Protoconch 500 µm wide, tip of apical fold broadly rounded; sculptured with fine, crisp, crowded granules and 4 fine spiral threads. Teleoconch up to 4.6 whorls; first whorl convex, next ca. 2.5 whorls with narrow sutural ramp with angulate rim overhanging suture, ramp obsolete thereafter, below subsutural rim spire whorls and periphery rather evenly rounded, base more weakly convex. Spire on first 2–3 whorls sculptured with fine, similar spiral cords that multiply by intercalation, 8 on first whorl, typically multiplying to 12–15 before becoming obsolete, rim of sutural ramp with or without low, rounded axially elongate nodules after second whorl. Fine collabral and spiral growth lines throughout. Um-

bilicus rather narrow, rim tightly rounded and projecting inwards to overhang convex wall. Aperture subcircular, outer lip thin at rim, weakly thickened within, simple, inner lip strongly thickened and finely granulate against umbilical rim. Animal unknown.

Type material: Holotype NMNZ M.131541 and 2 paratypes M.131542, from type locality, 21 June 1978, R/V *Tangaroa*. Paratypes (8): Middlesex Bank, NW of Three Kings Islands, 33°59.9'S, 171°45.3'E, 186–196 m, 31 January 1981, R/V *Tangaroa* (3, M.131544); 37 km SW of Great Island, 34°20.4'S, 171°48.2'E, 440 m, 21 June 1978, R/V *Tangaroa* (4, NMNZ M.131546; I AMS).

Type locality: 39 km SW of Great Island, Three Kings Islands, 34°17.6'S, 171°45.3'E, 427 m.

Other material examined (38 broken or immature specimens NMNZ): 37 km NE of Great Island, Three Kings Islands, 33°58.0'S, 172°30.6'E, 550 m, 25 June 1978, R/V *Tangaroa* (2, M.131548); Middlesex Bank, NW of Three Kings Islands, 33°59.9'S, 171°45.3'E, 186–196 m, 31 January 1981, R/V *Tangaroa* (7, M.131545); Three Kings Trough, NW of Three Kings Islands, 34°00'S, 171°55'E, 805 m, 15 July 1962, R.N.Z.F.A. *Tui* (4, M.59363); 13 km N of Great Island, 34°01.8'S, 172°12.0'E, 508 m, 23 June 1978, R/V *Tangaroa* (2, M.131550); Middlesex Bank, 34°02.0'S, 171°44.0'E, 246–291 m, 31 January 1981, R/V *Tangaroa* (4, M.131551); Middlesex Bank, 34°02.1'S, 171°45.8'E, 221–206 m, 31 January 1981, R/V *Tangaroa* (1, M.131552); 22 km ENE of Great Island, 34°05.0'S, 172°24.6'E, 200 m, 24 June 1978, R/V *Tangaroa* (5, M.131553); 39 km SW of Great Island, 34°17.6'S, 171°45.3'E, 427 m, 21 June 1978, R/V *Tangaroa* (10, M.131543); 37 km SW of Great Island, 34°20.4'S, 171°48.2'E, 440 m, 21 June 1978, R/V *Tangaroa* (3, M.131547).

Distribution (Figure 90): Off Three Kings Islands, 186–805 m (dead), in comminuted Bryozoa and shell.

Remarks: Compared with *Archiminolia meridiana*, the color bands in *A. episcopalis* are stronger, the sutural ramp is outwardly adapically sloping rather than horizontal, and the axial sculpture in the subsutural zone consists of nodules rather than short costae. *Archiminolia episcopalis* differs further in having a smaller protoconch (width 500 µm, cf. 570–630 µm).

Etymology: Overseer (Latin).

Archiminolia regalis new species
(Figures 90, 96–99)

Description: Shell up to 10.3 mm wide, wider than high, sturdy, narrowly umbilicate, highly polished. Protoconch white. Ground color of first 2.5–3.0 teleoconch whorls pale yellow, last whorl white or pale greenish or dull reddish white. Second and subsequent whorls with irregular pale dull red or olive green wavy axial bands that extend from suture to about midway across base and that are interrupted over middle third of spire whorls.

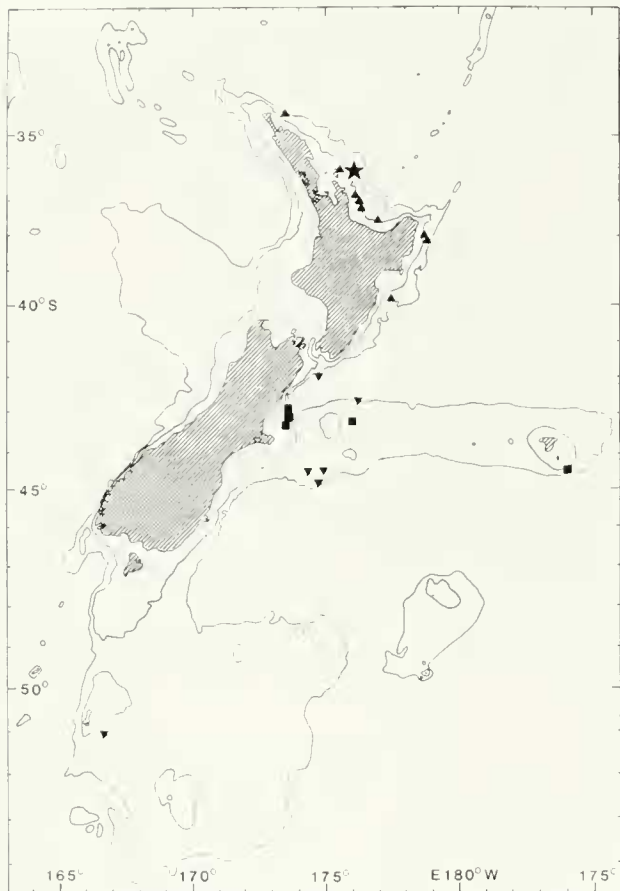


Figure 91. Map of New Zealand region showing distribution of species of *Zetela* (200 and 1000 m isobaths indicated): *Z. textilis* (Murdoch and Suter) (▲), *Z. tangaroa* new species (▼), *Z. variabilis* Dell (■), and *Z. annectens* new species (★).

and at middle of outer half of base to form more or less discrete subsutural, peripheral, and basal zones; subsutural zone and adapical extremity of peripheral zone most deeply pigmented; umbilical rim and inner lip porcellaneous white. Protoconch 500–530 μm wide, sculptured with 5 fine, crisp spiral threads and sparse granules, tip of apical fold broadly rounded. Teleoconch up to 4.5 whorls: narrow, more or less horizontal sutural ramp with tightly rounded rim; convex from ramp to umbilical rim though distinctly flattened above and below periphery. Spire on first 2 whorls sculptured with fine spiral cords that multiply by intercalation and enlarge to resemble adjacent spirals, about 20 near end of second whorl, weakening and becoming obsolete early on third whorl. Low rounded axial pleats on subsutural ramp. Fine collabral growth lines throughout. Umbilicus perspective to protoconch, rim tightly rounded, wall almost vertical, wall of each whorl shallowly concave beside rim, convex within. Aperture subcircular, outer lip thin at rim, moderately thickened within, simple, inner lip strongly thickened. Radula (optical preparation from

dried animal) characteristic of the genus, lateromarginal tooth broad.

Type material: Holotype NMNZ M.131513, from type locality, 31 January 1981, R/V *Tangaroa*. Paratypes (9): Middlesex Bank, 33°59.9'S, 171°45.3'E, 186–196 m, 31 January 1981, R/V *Tangaroa* (2, M.131518); 13 km N of Great Island, Three Kings Islands, 34°01.8'S, 172°12.0'E, 508 m, 23 June 1978, R/V *Tangaroa* (1, M.131515); Middlesex Bank, 34°02.0'S, 171°44.0'E, 246–291 m, 31 January 1981, R/V *Tangaroa* (3, NMNZ M.131517; 1 AMS); off Northeast Island, Three Kings Islands, 34°08.5'S, 172°11'E, 102 m, 18 February 1974, R/V *Acheron* (2, 131514); SE of Great Island, 34°14.8'S, 172°13.6'E, collected alive, 173–178 m, 2 February 1981, R/V *Tangaroa* (1, M.131516).

Type locality: Middlesex Bank, NW of Three Kings Islands, 34°02.1'S, 171°45.8'E, 221–206 m.

Other material examined: 103 mostly immature or fragmentary specimens in 20 lots from off Three Kings Islands, NMNZ.

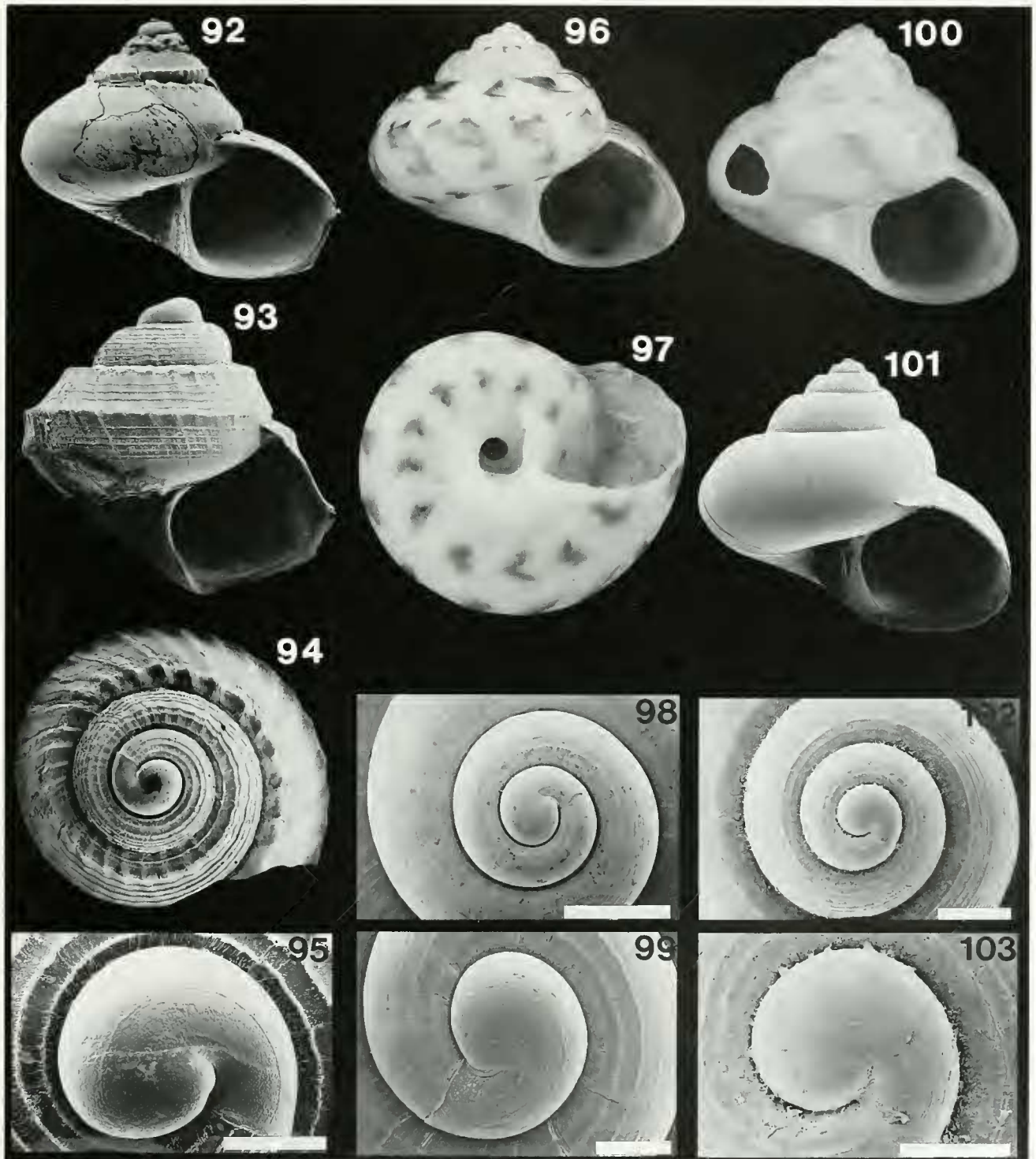
Distribution (Figure 90): Off Three Kings Islands, 91–805 m, collected alive at 173–178 m on comminuted bryozoan substratum with sponges, corals, hydroids, etc.

Remarks: *Archiminolia regalis* most closely resembles the Kermadec Ridge species *A. dawsoni* in general facies but differs principally in having a larger protoconch (width 500–530 μm , cf. 330 μm) and in being larger relative to the number of whorls (width 9.70 mm, 4.3 TW, cf. 9.10 mm, 5.2 TW). *Archiminolia regalis* is the most brightly and variably colored solarielline in the New Zealand region. A similar species occurs on Wanganella Bank, Norfolk Ridge, and is described below.

Etymology: Regal (Latin).

Archiminolia wanganellica new species
(Figures 90, 100–103)

Description: Shell up to 8.60 mm wide, wider than high, sturdy, narrowly umbilicate, highly polished and slippery. Protoconch white; first 2 teleoconch whorls very pale red; subsequent whorls white with pale yellowish brown, irregular, wavy axial bands that extend from suture or middle of spire whorls to midpoint of base, predominant green of nacreous layer showing through translucent outer shell layer; umbilical rim and inner lip porcellaneous white. Protoconch 470–480 μm wide, sculptured with about 5 fine spiral threads and minute granules, tip of apical fold broadly rounded. Teleoconch up to 4.6 whorls; second and third whorls with narrow, more or less horizontal sutural ramp with tightly rounded rim; convex from ramp to umbilical rim, weakly flattened above and below periphery. Spire on first 2 whorls sculptured with fine spiral threads that multiply by intercalation and enlarge to resemble adjacent spirals, 13–19 near end of second whorl, becoming obsolete early on third whorl. Fine collabral growth lines throughout.



Figures 92–103. Shells of species of *Archiminolia*. **92–95.** *A. diplax* new species **92**. Holotype (adult), NE of Mayor Island, 753–826 m, M.60166 (8.80 × 11.0 mm). **93–95.** Juvenile paratype, SE of Aldermen Islands, 807–872 m, M.75065 (2.50 × 2.70 mm). **96–99.** *A. regalis* new species **96**, **97**. Middlesex Bank, 221–206 m, M.131513 (7.70 × 9.70 mm). **98**, **99**. Paratype, off Northeast Island, Three Kings Islands, 102 m, M.131514. **100–103.** *A. wanganellica* new species, Wanganella Bank summit, 133 m. **100**. Paratype, M.131537 (7.50 × 8.30 mm). **101–103.** Holotype, M.131536 (6.20 × 6.90 mm). Scale bars **98**, **102** = 500 μ m. others = 250 μ m.

Umbilicus perspective to protoconch, rim tightly rounded, wall almost vertical, wall of each whorl shallowly concave beside rim, convex within. Aperture subcircular, outer lip thin at rim, moderately thickened within, simple, inner lip strongly thickened.

Type material: Holotype NMNZ M.131536 and 6 paratypes (3, NMNZ M.131537; 1 AMS), from type locality, 30 January 1981, R/V *Tangaroa*, collected alive (dried).

Type locality: Summit of Wanganella Bank, Norfolk Ridge, 32°39.2'S, 167°31.7'E, 133 m.

Other material examined: Wanganella Bank, summit, 32°32.2'S, 167°30.7'E, 113 m, 29 January 1981, R/V *Tangaroa* (1 immature, NMNZ M.257230); slope of Wanganella Bank, 32°10.5'E, 167°21.2'E, 449–442 m, 25 January 1977, R/V *Tangaroa* (7, NZOI P13); Wanganella Bank, summit, 32°39.2'S, 167°31.7'E, 133 m, 30 January 1981, R/V *Tangaroa* (7 broken or immature, M.131538); Wanganella Bank, summit, 32°40.0'S, 167°33.6'E, 133 m, 30 January 1981, R/V *Tangaroa* (8 immature, NMNZ M.131602).

Distribution (Figure 90): Wanganella Bank, Norfolk Ridge, 113–449 m, collected alive at 133 m from substratum of white sand and rhodolith gravel with small red algae.

Remarks: *Archiminolia wanganellica* differs from the similar species *A. dawsoni* and *A. regalis* in protoconch size (width 470–480 µm, cf. 330 µm and 500–530 µm), and size relative to the number of whorls (width 8.60 mm, 4.6 TW, cf. 9.10 mm, 5.2 TW and 10.4 mm, 4.3 TW); it differs further from *A. regalis* in that the earliest teleoconch whorls are pale red instead of yellow.

Etymology: Named after the type locality.

Archiminolia dawsoni (Marshall, 1979)
(Figure 81)

Solariella (*Microgaza*) *dawsoni* Marshall, 1979: 533, fig. 5D–F.

Type material: Holotype (H257) and paratype NZOI, from type locality, 25 July 1974, R/V *Tangaroa* (K825).

Type locality: Kermadec Ridge, NE of Raoul Island, 28°47.8'S, 177°47.8'W, 145 m.

Distribution: Kermadec Ridge NE of Raoul Island, 145 m.

Remarks: The holotype and paratype remain the only specimens of *Archiminolia dawsoni* seen to date. Superficially similar species from off the Three Kings Islands (*A. regalis* new species) and Wanganella Bank (*A. wanganellica* new species) are described above. The protoconch of *A. dawsoni* is exceptionally small for the genus (width 330 µm).

Archiminolia hurleyi (Marshall, 1979)
(Figure 86)

Solariella (*Microgaza*) *hurleyi* Marshall, 1979: 534, fig. 5G–I.

Type material: Holotype NZOI H256, from type locality, 25 July 1974, R/V *Tangaroa* (K825).

Type locality: Kermadec Ridge, NE of Raoul Island, 28°47.8'S, 177°47.8'W, 145 m.

Distribution: Kermadec Ridge NE of Raoul Island, 145 m.

Remarks: This species is transferred from *Solariella* (*Microgaza*) to *Archiminolia* because of its general resemblance to the type species. As with *A. dawsoni*, the protoconch is unusually small among *Archiminolia* species from the southwestern Pacific (width 330 µm).

Genus *Microgaza* Dall, 1881

Microgaza Dall, 1881: 50. Type species (by original designation): *Microgaza rotella* Dall, 1881; Recent, West Indies.

Remarks: As discussed above, species of *Microgaza* resemble *Bathymophila* and *Archiminolia* species but differ from *Bathymophila* species in that the umbilicus does not become covered by a thick, granulate septum at maturity and have broad lateromarginal radular teeth without a terminal flagellum; species of *Microgaza* differ from both groups in having a wider umbilicus. The species described below is closer to the West Indian type species in shell facies than to any species here referred to *Bathymophila* or *Archiminolia*. The only other named species known from outside the Caribbean is *M. nava-kaensis* Ladd, 1982, described from the Pleistocene of Santo, Vanuatu, which also occurs living off southern New Caledonia (AMS C.328490, MNHN). I have examined additional, unnamed species from off Western Australia (AMS C.170029) and off Crocker Island in the Arafura Sea (AMS C.328491).

Microgaza norfolkensis new species
(Figures 75, 104–106)

Description: Shell up to 16.3 mm wide, wider than high, thin, widely umbilicate, highly polished. Protoconch and first 2.5 teleoconch whorls white; next 1.5 whorls pinkish buff, last half whorl white with narrow, irregular wavy axial band on spire, base white. Protoconch 400 µm wide, tip of apical fold broadly rounded. Teleoconch up to 5 whorls, first 2 whorls strongly convex, subsequent whorls more weakly convex on spire and base, periphery strongly convex. Spire on first 2 whorls sculptured with 6 crisp spiral threads, interspaces wider than each thread, rapidly becoming obsolete thereafter; numerous fine, crowded, rounded spiral threads commencing on fourth whorl, crisp on spire and periphery, more weakly defined on base; low, rounded axial costae commencing about midway through second whorl, entirely traversing spire whorl at first, progressively enlarg-

ing and becoming obsolete abapically to form subsutural zone of rounded axial pleats, becoming obsolete on first half of third whorl or late on fourth whorl. Inner quarter of base and umbilical rim with close, rounded axial pleats separated by grooves. Umbilical rim strongly angulate, surmounted by rounded spiral cord, umbilical wall evenly and moderately convex, sculptured with crisp spiral lirae and collabral growth lines. Umbilicus perspective to protoconch. Aperture ovate, lips thin at rim, weakly thickened within, simple. Animal unknown.

Type material: Holotype NZOI H685 and paratype NMNZ M.131567, from type locality, 30 January 1977, R/V *Tangaroa* (P45).

Type locality: Off Norfolk Island, 28°42.0'S, 167°57.8'E, 527–508 m.

Distribution (Figure 75): Off Norfolk Island, 527–508 m (dead).

Remarks: *Microgaza norfolkensis* is strikingly similar to the tropical western Atlantic species *Microgaza rotella* (Dall, 1881) in general facies but differs in attaining more than twice the size (width up to 16.3 mm, cf. 6.80 mm), in having a larger protoconch (width 400 μ m, cf. 330–350 μ m), in having a more broadly rounded periphery, and in having stronger spiral lirae on the last adult whorl. *Microgaza navakaensis* Ladd, 1982, from the Pleistocene of Santo, Vanuatu, differs in being smaller relative to the number of whorls and in having a color pattern of crowded, wavy axial bands (Ladd, 1982, pl. 34, fig. 1–5).

Genus *Zetela* Finlay, 1926

Zetela Finlay, 1926: 359. Type species (by original designation): *Minolia textilis* Murdoch and Suter, 1906; Recent, New Zealand.

?*Lamellitrochus* Quinn, 1991: 81. Type species (by original designation): *Margarita lamellosa* Verrill and Smith, 1880; Recent, eastern North America.

Remarks: The type species of *Zetela* is distinctive in having strong, reticulating spiral and axial sculpture and crisp granules on the teleoconch and in not having the innermost marginal modified to form a lateromarginal plate (figures 134–138). The animal of *Zetela textilis* (preserved material, NMNZ M.58797) has a broad, rounded neck lobe on the right side connected to the eyestalk, a tiny tentaculiform neck lobe below the left eyestalk, and four epipodial tentacles on each side, the anterior and posterior pairs long and slender, the middle pairs minute. The periostracum is apparently calcified (intritacalx) in all species, though as in *Solariella* (short of examination of cross sections of fractured shells), its presence is only revealed by the effects of solution etching in a few species.

The southern African species *Solariella intermissa* Thiele, 1925 (Herbert, 1987, fig. 115—"ml" and "hl" are transposed) and the closely related species *Z. kopua* new species differ from *Z. textilis* in having an extra

(posterior) neck lobe on the left side but are otherwise similar. Like *Z. textilis*, both species lack lateromarginal plates in the radula, though unlike *Z. textilis*, the tooth that gives rise to it has a reduced cutting area. According to Quinn's (1991) composite description of the external anatomy, species of *Lamellitrochus* Quinn, 1991, have two left neck lobes and three epipodial tentacles on each side, the middle one long or short. The condition in the type species (*Margarita lamellosa* Verrill and Smith, 1880) was not specified, though from study of preserved material kindly lent by J.F. Quinn, there are actually four pairs of epipodial tentacles, the two middle pairs much smaller as in *Z. textilis*. All of these Atlantic species resemble *Z. textilis* in having strong axial sculpture, at least on the early teleoconch, a protoconch with a bulbous tip and fine spiral threads, and a teleoconch microsculpture of minute granules. The type species and most other species referred to *Lamellitrochus* by Quinn (1991) differ markedly from *Z. textilis* in that the later spire whorls are more weakly convex and sculptured with three angulating primary spiral cords (abapical spiral more or less covered by succeeding whorls). Differences in shell morphology between *L. lamellosus* and *Z. textilis*, however, are bridged via *L. fenestratus* Quinn, 1991, *L. carinatus* Quinn, 1991, *L. bicoronatus* Quinn, 1991, and *Zetela variabilis* Dell, 1956. Since *Lamellitrochus* and *Zetela* species also have similar external anatomies and radulae, it seems likely that *Lamellitrochus* is a synonym of *Zetela*. A New Zealand *Zetela* species resembling Atlantic *Lamellitrochus* species is described below.

The shells of *Zetela textilis* and *Lamellitrochus lamellosus* are similar to the *affinis* form (figure 40) and the holotype (Warén, 1993, fig. 2A), respectively, of *Solariella amabilis* (Jeffreys, 1865), in which, however, lateral four is relatively larger and the innermost marginal has been transformed into a broad lateromarginal plate (Warén, 1993, fig. 7B), and there are three pairs of similar epipodial tentacles and a rounded flap-like structure between the two anterior pairs of epipodial tentacles. As discussed above, *S. amabilis* apparently belongs in *Solariella sensu stricto*.

Zetela textilis (Murdoch and Suter, 1906)
(Figures 91, 109, 110, 134)

Minolia textilis Murdoch and Suter, 1906: 298, pl. 26, fig. 45, 46.

Monilea (Minolia) textilis.—Suter, 1913: 143, pl. 33, fig. 14, 14a.

Zetela textilis.—Finlay, 1926: 359.

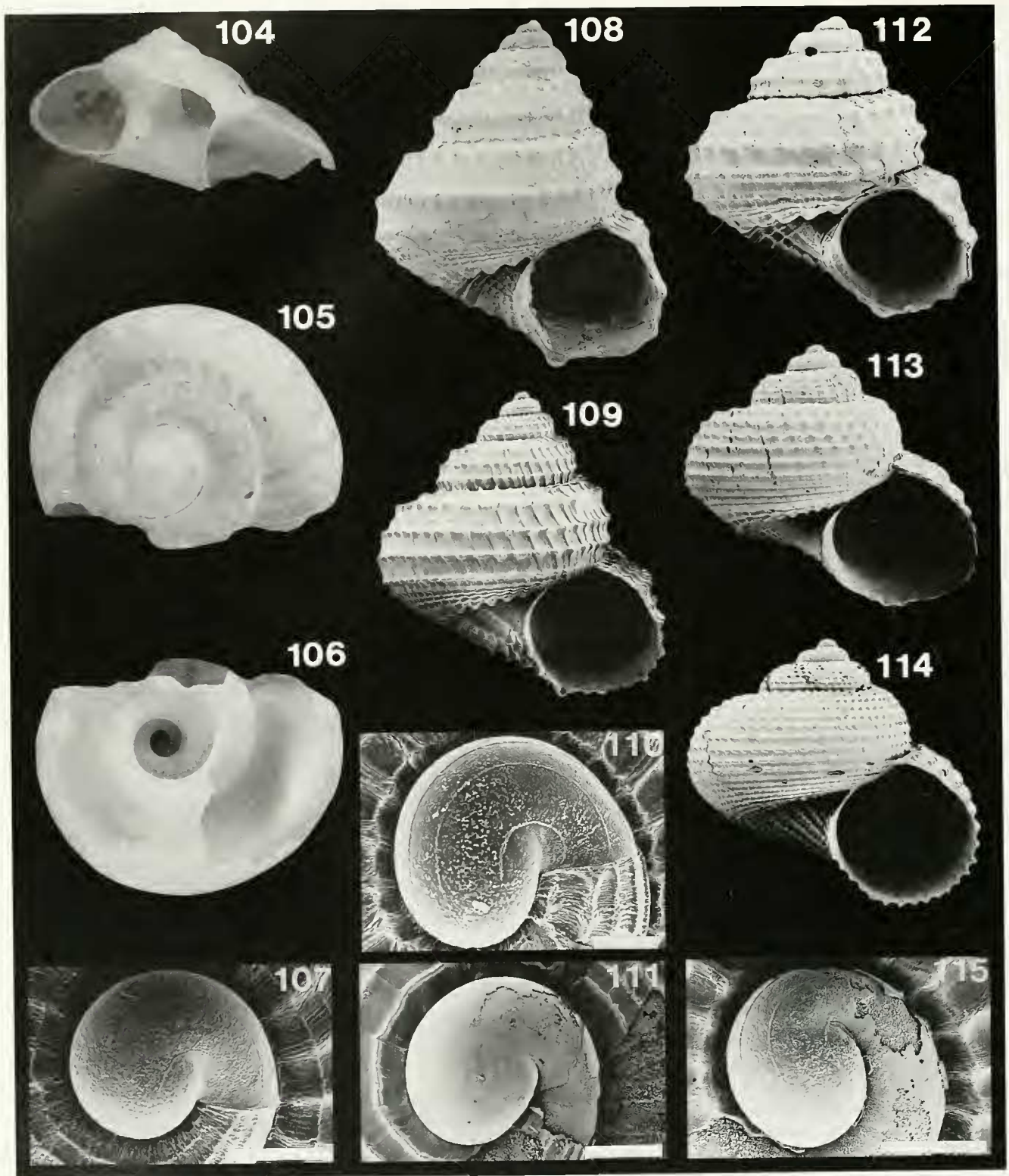
Isanda (Zetela) textilis.—Wenz, 1938: 318, fig. 720.

Solariella (Zetela) textilis.—Keen, 1960: 262, fig. 167/1; Powell, 1974: 207; Powell, 1979: 64, pl. 17, fig. 20.

Type material: Holotype NMNZ M.1123, from type locality, S.S. *Awarua*.

Type locality: Off Great Barrier Island, 36°08'S, 175°55'E, 201 m, 22 January 1904.

Other material examined (ca. 1000 specimens



Figures 104–115. Shells of species of *Microgaza* and *Zetela*. **104–106.** *Microgaza norfolkensis* new species, holotype, off Norfolk Island, 527–508 m, NZOI H685 (16.3 × 7.00 mm). **107, 112, 113.** *Zetela variabilis* Dell. **107, 113.** Pegasus Canyon, NE of Banks Peninsula, 1006–512 m, M.52779 (107, juvenile; 113, 4.35 × 4.90 mm). **112.** Pegasus Canyon, 256–293 m, M.94763 (4.65 × 4.70 mm). **108.** *Zetela annectens* new species, holotype, off Great Barrier Island, 486–655 m, M.137596 (5.80 × 5.05 mm). **109, 110.** *Zetela textilis* (Murdoch and Suter). **109.** SE of The Aldermen, 178–248 m, M.65154 (4.35 × 4.30 mm). **110.** Off Mayor Island, 256–311 m, M.35478. **111, 114.** *Zetela tangaroa* new species, holotype, SE of Banks Peninsula, 760 m, NZOI H686 (4.75 × 5.55). **115.** *Zetela kopua* new species, paratype, N Bounty Trough, 1373 m, NZOI P1126. Scale bar 110 = 120 μm, others = 250 μm.

NMNZ): E of North Cape, 34°25.0'S, 173°13.1'E, collected alive, 327–257 m, 27 January 1981, R/V *Tangaroa* (71, M.131497); SE of Aldermen Islands, 37°00.8'S, 176°12.3'E, collected alive, 178–248 m, 23 January 1979, R/V *Tangaroa* (many, M.65154); SE of Aldermen Islands, 37°01.0'S, 176°14.8'E, collected alive, 357–312 m, 24 January 1981, R/V *Tangaroa* (1, M.131498); NNW of Mayor Island, 37°08.7'S, 176°14.2'E, 356–380 m, 23 January 1979, R/V *Tangaroa* (2, M.61047); NW of Mayor Island, 37°09.6'S, 176°12.2'E, 293–348 m, 22 January 1979, R/V *Tangaroa* (1, M.61028); NW of Mayor Island, 37°11.5'S, 176°10.0'E, collected alive, 198–273 m, 22 January 1979, R/V *Tangaroa* (35, M.66560); off Mayor Island, 37°12'S, 176°17'E, collected alive, 256–311 m, 9 February 1974, R/V *Acheron* (9, M.35478); SE of Mayor Island, 37°21.9'S, 176°20.9'E, collected alive, 203–248 m, 22 January 1979, R/V *Tangaroa* (3, M.61319); off Mayor Island, Bay of Plenty, 37°22.5'S, 176°22'E, 207–220 m, 27 February 1957, M.V. *Alert* (10, M.12868); N of Motuhora Island, 37°35.1'S, 176°59.5'E, collected alive, 248–213 m, 20 January 1979, R/V *Tangaroa* (6, M.65022); N of Motuhora Island, 37°37.8'S, 176°59.9'E, collected alive, 129–139 m, 20 January 1979, R/V *Tangaroa* (21, M.67785); ENE of Tokomaru Bay, 37°59.7'S, 178°40.0'E, collected alive, 144 m, 16 January 1979, R/V *Tangaroa* (43, M.59846); ENE of Tolaga Bay, 38°15.2'S, 178°38.6'E, collected alive, 139 m, 16 January 1979, R/V *Tangaroa* (29, M.59797); SE of Cape Kidnappers, 39°55.5'S, 177°30'E, 183 m, 20 May 1952, M.V. *Kotuku* (1, M.8748).

Distribution (Figure 91): North Island east coast, from North Cape to Cape Kidnappers, 129–380 m; collected alive at 139–327 m from mud.

Remarks: *Zetela textilis* attains 5.60 mm in width, is uniform translucent white, and has a highly distinctive sculpture of prominent axial lamellae that are narrowly and sharply angulate in section and strong, rounded spiral cords, with sharply nodular intersections on the spire and at the umbilical rim.

Zetela variabilis Dell, 1956
(Figures 91, 107, 112, 113)

Zetela variabilis Dell, 1956: 48, fig. 70, 74.
Solariella (Zetela) variabilis.—Powell, 1976: 84; Powell, 1979: 64.

Description: Shell up to 5.75 mm wide, wider than high or about as high as wide at maturity, of moderate thickness, umbilicate, white. Protoconch 530–570 µm wide, tip of apical fold broadly rounded; sculptured with fine, crisp, irregular granules, and 3 fine, crisp spiral threads. Teleoconch up to 3.60 whorls, first whorl rather evenly convex; subsequent whorls convex below angulation at rim of gently sloping subsutural ramp, base distinctly flattened, umbilical rim angulate. Sculptured with rounded spiral cords and strong, rounded axial costae. Spiral cords numbering 5 or 6 at end of first whorl, abapical spiral either fully exposed through-

out or almost covered by succeeding whorls; on subsequent whorls all spirals strong and similar, or 1 or 2 on side of spire may vanish on second whorl then reappear later at varying stages in the same positions, these remaining weaker than adjacent spirals, 4–7 on adult penultimate whorl, and 3–9 on base; rounded nodules at intersections with axial costae, strong on spire, strongest at umbilical rim, of intermediate strength on other spirals, nodules at umbilical rim less numerous than axials on spire. Axial costae strong on spire and at umbilical rim, almost obsolete on outer base, evanescent over outer umbilical wall. First whorl with microsculpture of numerous fine, crisp axial threads, weakening and vanishing early on next whorl. Umbilicus funnel-shaped, narrow within, rim moderately angulate; outer part of wall of last whorl almost flat, convex within, sculptured with inwardly weakening spiral cords and axial riblets. Aperture subcircular, lips thin at rim, moderately thickened within, simple. Animal (alcohol, NMNZ M.65164) with broad flap-like neck lobe on right side fully fused with eyestalk, 1 small tentaculiform left neck lobe, and 4 epipodial tentacles on each side; anterior and posterior tentacles on left side long and slender, middle 2 minute; anterior tentacle and posterior 2 tentacles on left side long and slender, anterior second tentacle much smaller. The radula (optical preparation) is similar to that of *Z. textilis*.

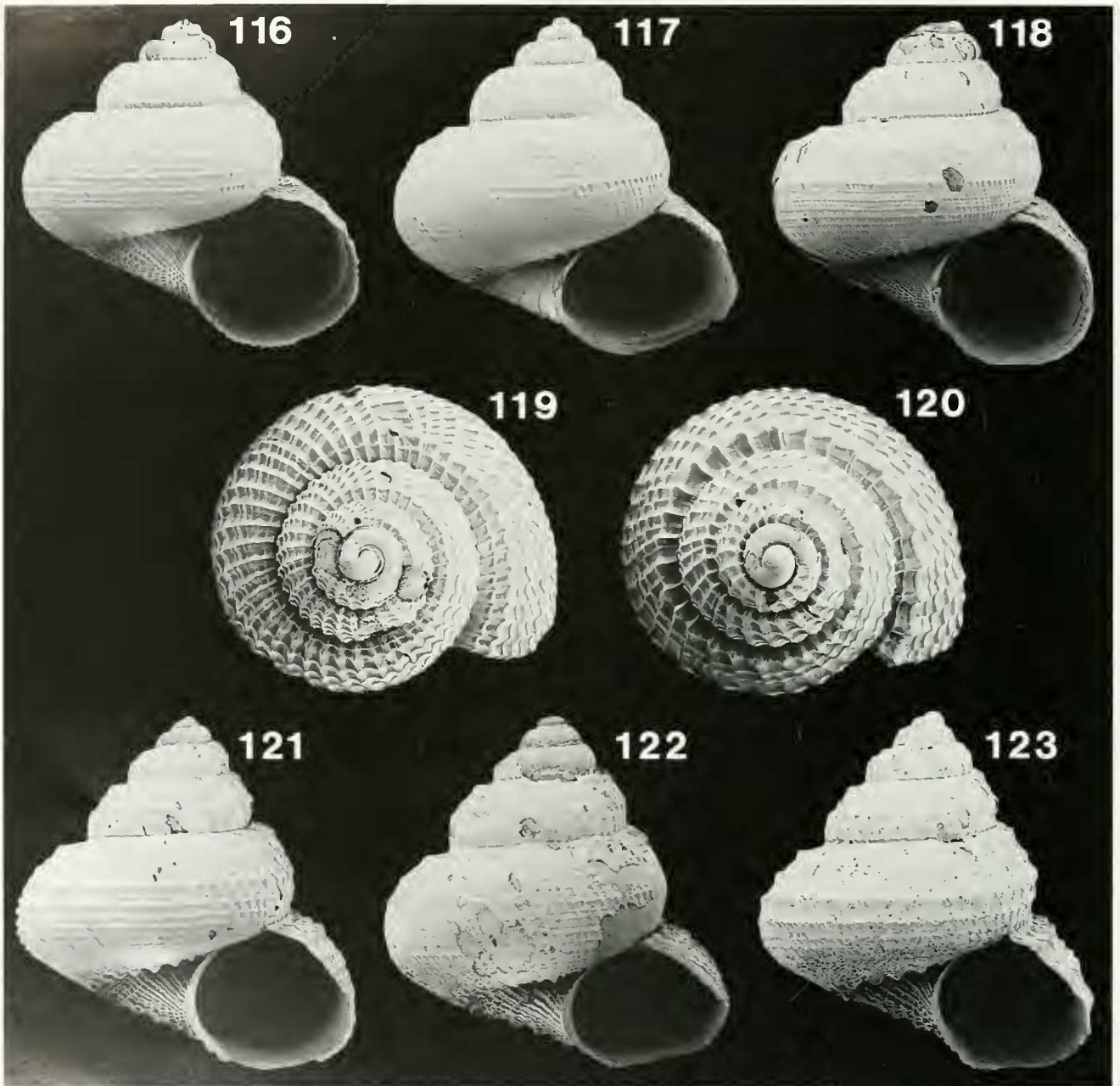
Type material: Holotype NMNZ M.9768, from type locality, 3 February 1954, M.V. *Alert*.

Type locality: SE of Pitt Island, Chatham Islands, 44°32'S, 176°05'W, 284 m.

Other material examined (40 specimens NMNZ): Off Waiiau River mouth, S of Kaikoura, 42°55'S, 173°43'E, 549–586 m, 18 March 1976, R/V *Acheron* (6, M.50888); up steep wall of Pegasus Canyon, NE of Banks Peninsula, 43°14'S, 173°39'E, collected alive, 1006–512 m, 27 September 1976, R/V *Acheron* (15, M.52779); Pegasus Canyon, NE of Banks Peninsula, 43°25.0'S, 173°26.0'E, collected alive, 485–476 m, 21 February 1979, R/V *Acheron* (2, M.65164); Pegasus Canyon, 43°31.0'S, 173°30.5'E, 256–293 m, 21 February 1979, R/V *Acheron* (15, M.94763); Chatham Rise, 43°14'S, 176°11'E, 366 m, 23 January 1954, M.V. *Alert* (1, M.10839); SE of Pitt Island, Chatham Islands, 44°32'S, 176°05'W, 284 m, 3 February 1954, M.V. *Alert* (1, M.10838).

Distribution (Figure 91): Off Banks Peninsula and Chatham Islands, and Chatham Rise, 256–1006 m; collected alive at 476 m and 512–1006 m from mud with shell and/or coral.

Remarks: *Zetela variabilis* resembles *Z. textilis* in size and in being translucent white, but differs principally in that the axial costae on the spire whorls are broadly rounded in section instead of sharply and narrowly angulate. The original specimens of *Zetela variabilis* are all



Figures 116–123. *Zetela kopua* new species. **116.** Holotype, N Bounty Trough, 1386 m, holotype NZOI H687 (9.00 × 9.50 mm). **117.** N Three Kings Rise, 1570–1563 m, NZOI U601 (9.10 × 9.35 mm). **118.** S Lord Howe Rise, 2417–2421 m, NZOI U226 (10.9 (est.) × 9.40 mm). **119.** Paratype, N Bounty Trough, 1373 m, NZOI P1126 (width 4.70 mm). **120–122.** S Lord Howe Rise, 1573 m, NZOI U198 (120, width 4.60 mm; 121, 6.80 × 6.50 mm; 122, 8.30 (est.) × 7.85 mm). **123.** S Lord Howe Rise, 1186 m, NZOI U197 (7.55 × 7.35 mm).

juveniles (holotype 2.5 × 2.70 mm, 2.5 teleoconch whorls), and the species is redescribed from adult material. It is aptly named, for adults prove to have exceptionally variable sculpture. Despite the great differences between the extremes (figures 112, 113), none of the differences are constant and it seems clear that all represent a single highly polymorphic species.

Zetela annectens new species
(Figures 91, 108)

Description: Shell (holotype) up to 5.80 mm high, slightly higher than wide at maturity, of moderate thickness, umbilicate, chalky white (lightly solution etched). Protoconch about 500 μm wide, tip of apical fold broad-

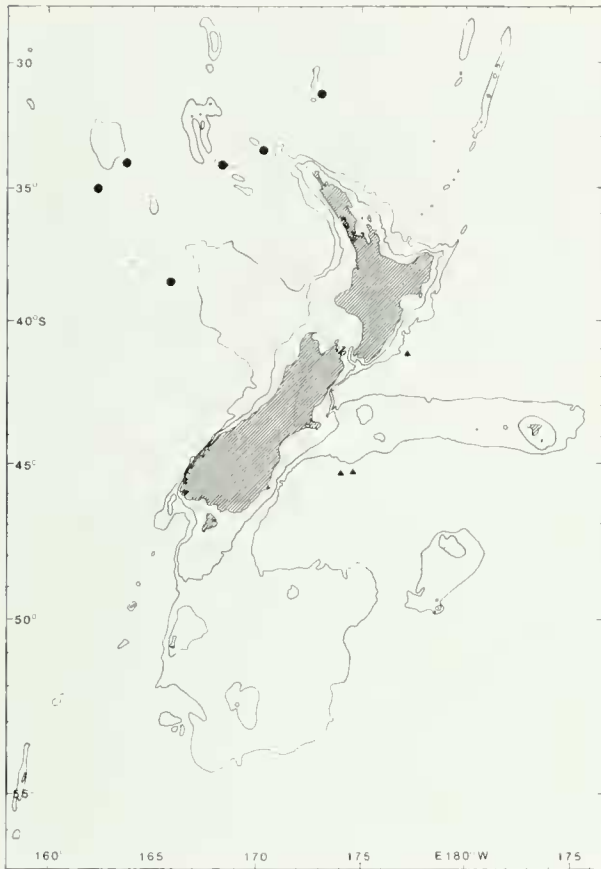


Figure 124. Map of New Zealand region show distribution of *Zetela kopua* new species (200 and 1000 m isobaths indicated).

ly rounded, sculpture unknown (surface and rim etched away). Teleoconch up to 4.5 whorls, first whorl rather evenly convex; subsequent whorls with gently sloping sutural ramp with strongly angulate rim, weakly convex above and below angulate periphery, umbilical rim angulate. Sculptured with rounded spiral cords and narrow, more or less collabral axial riblets, rounded conical nodules at intersections. Earliest whorls eroded but with at least 4 spiral cords, spiral 2 (numbering abapically) becoming obsolete on third whorl; cords on subsequent whorls numbering 3 on spire and 4 on base. Spire spirals at shoulder angulation, submedially and at periphery, strongly nodular; submedian and peripheral spirals strongest and similar, summit of peripheral spiral exposed on spire; basal spirals similar, more weakly nodular than spire spirals. Axial riblets traversing spire and base, evanescent within umbilicus, with increasing shell size increasing numbers intercalating between shoulder angulation and umbilical rim, so that number of nodules on spirals between shoulder spiral and umbilical rim becomes about 3 times greater than on shoulder spiral and umbilical rim. Umbilicus deep, funnel-shaped, angulate rim with strong, roundly conical nodules; wall convex, sculptured with 3 spiral threads on outer part and axial

riblets. Aperture subcircular, lips thin at rim, weakly thickened within, inner lip with moderate median angulation, separated from outer lip by strong basal angulation. Animal unknown (shell of holotype too fragile to risk extraction).

Type material: Holotype NMNZ M.137596 and 1 juvenile paratype M.137597, from type locality, 25 January 1981, R/V *Tangaroa*, collected alive.

Type locality: E of Great Barrier Island, 36°12.0'S, 176°19.4'E, collected alive, 486–655 m.

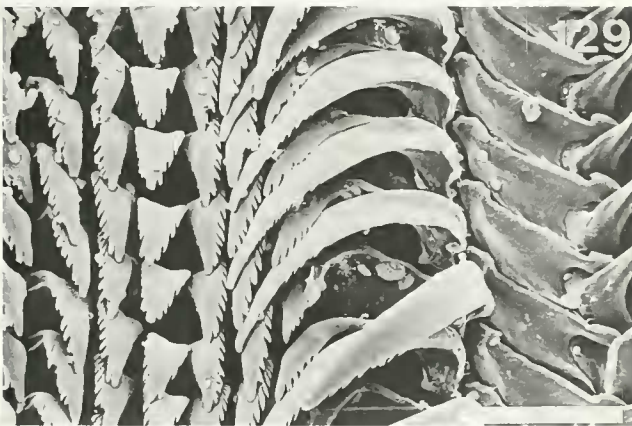
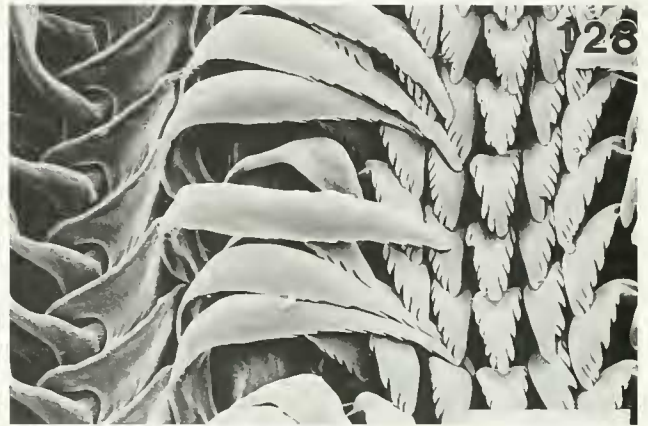
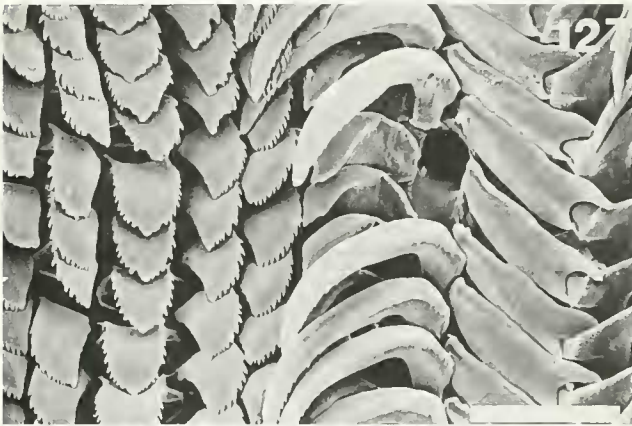
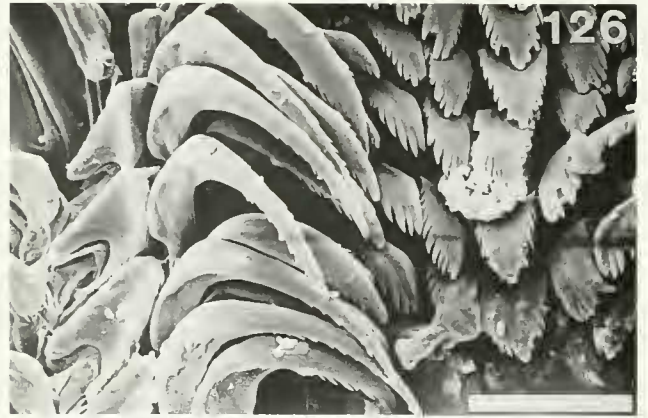
Distribution (Figure 91): Off Great Barrier Island, 486–655 (alive), in mud with foraminiferans and coral.

Remarks: *Zetela annectens* is strikingly similar to western Atlantic species referred to *Lamellitrochus* by Quinn (1991), from all of which it differs, however, in having only 4 spiral cords on the base and no secondary spiral sculpture on the last few adult whorls.

Etymology: Linking, joining (Latin), an allusion to similarity to Western Atlantic species.

Zetela kopua new species
(Figures 115, 116–124, 135, 136)

Description: Shell up to 14.2 mm wide, slightly wider than high, thin, rather narrowly umbilicate, translucent white. Protoconch 600–620 μ m wide, tip of apical fold broadly rounded; sculptured with fine, crisp, irregular granules and 3 fine, crisp spiral threads. Teleoconch up to about 5 whorls, first whorl evenly convex; subsequent whorls with narrow horizontal sutural ramp defined by angulate rim, strongly and rather evenly convex from ramp rim to suture within umbilicus. Reticulately sculptured with narrow, crisp spiral cords that multiply by intercalation and enlarge to resemble adjacent spirals and crisp, collabral axial riblets that are about as strong as spirals, interspaces wider than each spiral and axial, intersections finely beaded, spirals and axials roundly angulate in section. Axials continuous on first 2 whorls; thereafter strongest on and close beside subsutural ramp, increasing numbers of additional axials intercalating at irregular intervals in broad zone between abapical side of ramp rim and inner third of base, so that eventually there are about twice as many axials as in subsutural zone and on inner third of base. Spiral cords numbering 6 or 7 on first whorl, abapical spiral more or less covered by succeeding whorls, 19–25 on adult penultimate whorl. Umbilicus funnel-shaped, narrow within, rim evenly rounded; wall of last whorl evenly convex, sculptured as on base. Aperture subcircular, lips thin at rim, weakly thickened within, simple. Animal (alcohol, NZO1 stn S154) with broad, rounded right neck lobe, 2 small tentaculiform left neck lobes, and 4 epipodial tentacles on each side, anterior and posterior pairs long and slender, median pair much smaller, eyes pigmented. Radula (figures 135, 136) with the formula ca. 6 + 4 + 1 + 4 + ca. 6. Central and lateral teeth stout with



strongly flanged and grooved interlocking bases, laterals 1–3 outwardly elongating but with cutting areas outwardly decreasing in size, lateral 4 considerably longer. Cutting areas narrowly tapered, serrate on central tooth, outer edges (only) serrate on lateral teeth, terminal cusp on each strongest, that on lateral 4 longest. Marginal teeth slender, terminal cusp very long and slender, a tiny cusp on outer edge at about distal quarter.

Type material: Holotype NZOI H687 and 13 paratypes (3, NMNZ M.131532; 10, NZOI P1133), from type locality, 27 October 1979, R/V *Tangaroa* (S153), collected alive. Paratypes (12): Bounty Trough, E of Oamaru, 45°24.2'S, 173°59.8'E, collected alive, 1373 m, 27 October 1979, R/V *Tangaroa* (2, NMNZ M.131533; 10, NZOI S154/P1126).

Type locality: Bounty Trough, E of Oamaru, 45°21.1'S, 173°35.8'E, 1386 m.

Other material examined (20 specimens): N Three Kings Rise, 31°19.9'S, 173°05.1'E, 1570–1563 m, 9 February 1988, R/V *Rapuhia* (1, NZOI U601); Norfolk Ridge, 34°05'S, 168°10'E, S 1488–1556 m, 20 March 1968, M.V. *Taranui* (1, NZOI E870); Lord Howe Rise, SE of Lord Howe Island, 34°59.3'S, 162°11.21'E, collected alive, 1573 m, 26 September 1982, R/V *Tangaroa* (2, NMNZ M.131535; 3, NZOI U19S); Lord Howe Rise, SE of Lord Howe Island, 34°09.8'S, 163°36.7'E, 1186 m, 25 September 1982, R/V *Tangaroa* (1, NMNZ M.137598; 4, NZOI U197); Lord Howe Rise, SE of Lord Howe Island, 38°37.3'S, 165°36.0'E, 2417–2421 m, 16 October 1982, R/V *Tangaroa* (1, NMNZ M.131534; 3, NZOI U226); Hikurangi Trench, off Castlepoint, 41°11.9'S, 177°19.6'E, collected alive, 2200–2328 m, 18 June 1980, R/V *Tangaroa* (3, NZOI P971).

Distribution (Figure 124): Southern Lord Howe Rise, southern Norfolk Ridge, northern Three Kings Rise, southern Hikurangi Trench, and northern Bounty Trough, 1186–2421 m, living at 1373–2328 m in mud and foraminiferal ooze.

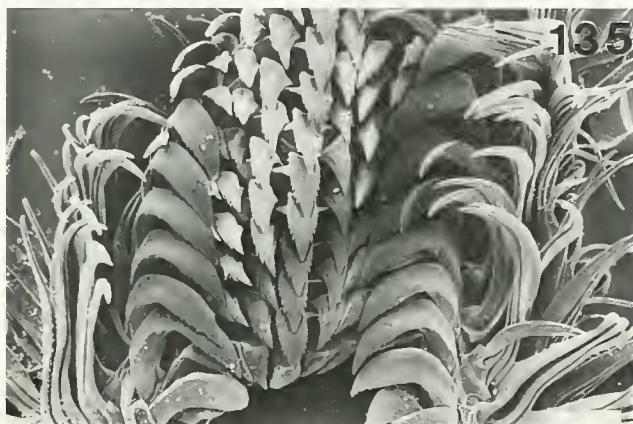
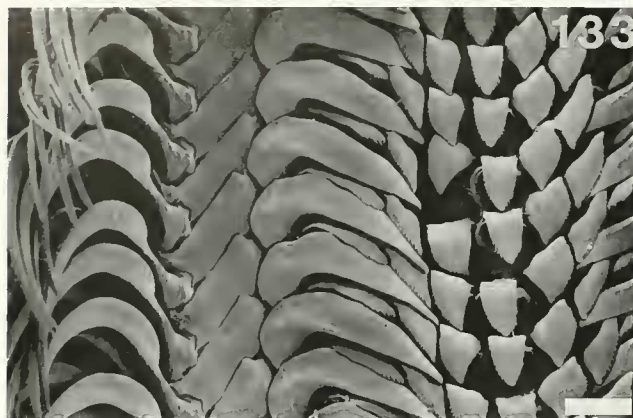
Remarks: Specimens from the Lord Howe Rise differ from specimens from southeastern New Zealand in having a submedian angulation on the spire, an angulate umbilical rim, and stronger, more widely spaced axial costae on the early teleoconch whorls, on the subsutural zone on later whorls, and at the umbilical rim (figures 116–123). Specimens from 2417–2421 meters depth on the Lord Howe Rise differ from specimens from both southern New Zealand and shallower depths on the Lord Howe Rise (1186–1573 m, figures 120–123) in hav-

ing two low angulations that divide the spire whorls into thirds. The single shell from the northern Three Kings Rise (figure 117) has an angulate umbilical rim, a weak supramedian angulation, an extremely weak submedian angulation, only a single spiral cord on the umbilical wall, and a larger protoconch (width 700 μm , cf. 600–620 μm) and considerably weaker axial costae on the early teleoconch whorls than in specimens from either Lord Howe Rise or southern New Zealand. The single incomplete shell from the southern Norfolk Ridge has evenly convex whorls, an angulate umbilical rim, and numerous spirals on the umbilical wall. Given the distances between Lord Howe Rise, northern Three Kings Rise and southeastern New Zealand and the fact that the populations are not significantly isolated by bathymetry, I am not convinced that distinct species are involved and assume that the various forms are local populations of a single polymorphic species and that morphologically and geographically intermediate populations may eventually be discovered.

Forms of *Z. kopua* from the Lord Howe Rise are strikingly similar to *Trochus (Margarita) rhina* Watson, 1886 (syntypes BMNH 1887.2.9.302–10), from bathyal and abyssal depths in the northeastern Atlantic, but *T. rhina* differs in having a smaller protoconch (width 500 μm , cf. 600–620 μm) and a rounded angulation on the umbilical wall, against which the inner lip is much thicker and roundly angulate. Specimens of *T. rhina* were well illustrated by Dautzenberg and Fischer (1896, pl. 20, fig. 15–17) and Dautzenberg (1927, pl. 5, fig. 35–37), who misidentified them as *Solariella cincta* (Philippi, 1836), an entirely different species (Warén, 1993, figs. B, C, E). Lord Howe Rise specimens are also similar to *S. intermissa* Thiele, 1925, from off southern Africa at 340–1280 meters depth (Herbert, 1987), but Lord Howe Rise and New Zealand specimens differ in having a larger protoconch (width 600–620 μm , cf. 450–500 μm) and a thinner inner lip. *Trochus rhina*, *S. intermissa*, and *Z. kopua* obviously belong in the same species group. Other possible congeners are *Solariella delicata* Dall, 1919 (holotype USNM 205780- Kosuge, 1972, pl. 2, fig. 6) and similar northwestern Pacific species described by Bagirov (1995), all of which differ from *Z. rhina*, *Z. intermissa*, and *Z. kopua*, however, in that axial riblets are not added by intercalation between the subsutural zone and the umbilical rim and in other sculptural details. Bagirov (1995) did not describe the animals or illustrate the marginal teeth of his species but did state that all of the marginal teeth are similar, so it would seem that they lack lateromarginal plates.

←

Figures 125–132. Radulae of species of *Solariella* and *Bathymophila*. **125.** *Solariella plicatula* (Murdoch and Suter), off Poor Knights Islands, 121–113 m, M.35876. **126.** *S. vera* (Powell), Middlesex Bank, 221–206 m, M.130063. **127.** *S. lutcola* (Powell), Middlesex Bank, 221–206 m, M.130055. **128.** *S. benthicola* (Powell), Middlesex Bank, 221–206 m M.130079. **129.** *S. peristicta* new species, King Bank, 128–123 m, M.131494. **130, 131.** *Bathymophila gravida* new species, ex holotype, N Three Kings Rise, 1137–1150 m. **132.** *B. tenuiseptum* new species, ex holotype, N Three Kings Rise, 790–780 m. Scales 125–129 = 50 μm , 130–132 = 100 μm .



Figures 133–138. Radulae of species of *Archiminolia* and *Zetela*. 133. *Archiminolia meridiana* (Dell), off Cape Kidnappers, 900 m, M.11812S. 134. *Zetela textilis* (Murdoch and Suter), off Mayor Island, 256–311 m, M.3547S. 135, 136. *Z. kopua* new species, ex holotype—Bounty Trough, E of Oamaru, 1356 m. 137, 138. *Z. tangaroa* new species, NE of Mernoo Bank, Chatham Rise, 999–954 m, M.59727. Scale 135 = 100 μm , others = 50 μm .

Etymology: Deep (Maori).

Zetela tangaroa new species
(Figures 91, 111, 114, 137, 138)

Description: Shell up to 7.50 mm wide, slightly wider than high, thin, rather narrowly umbilicate, translucent white. Protoconch 630 μm wide, obscurely and minutely granulate, a fine spiral thread beside suture, tip of apical

fold broadly rounded, bulbous. Teleoconch up to 4.0 whorls, strongly and rather evenly convex from suture on spire to suture within umbilicus. Sculptured with prominent crisp spiral cords that multiply by intercalation and enlarge to resemble adjacent spirals, and weak collabral axial riblets, intersections with well-developed nodules after first whorl, nodules on spire roundly conical on second whorl, roundly conical or becoming fully rounded on next whorl; nodules on adult base rounded

and weaker than on spire, roundly conical and as strong as on spire on umbilical wall. Spiral cords numbering 7 on first whorl, abapical spiral more or less covered by succeeding whorls, 10 on adult penultimate whorl, interspaces wider than each spiral. Axials fold-like on spire on first 1.5 whorls, thereafter almost obsolete on spire and base, though strong on umbilical wall. Umbilicus funnel-shaped, narrow within, rim evenly rounded, wall of last whorl evenly convex, strongly sculptured. Aperture subcircular, lips thin at rim, weakly thickened within, simple. Animal (alcohol, NZOI stn. S147) with broad, rounded right neck lobe and small tapered left neck lobe, 4 epipodial tentacles on each side, anterior and posterior pairs long and slender, middle pairs minute. Radula (figures 137, 138) with the formula ca. $6 + 4 + 1 + 4 +$ ca. 6. Central and lateral teeth stout with strongly flanged and grooved, interlocking bases, laterals 1–3 outwardly elongating but with cutting areas outwardly decreasing in size, lateral 4 considerably longer and with longer cutting area. Cutting areas narrowly tapered, serrate on central tooth, outer edges (only) serrate on lateral teeth, terminal cusp on each strongest. Marginal teeth slender, terminal cusp very long and slender, below which up to 6 minute cusps, fewer on outer teeth.

Type material: Holotype NZOI H.686 and 8 paratypes (2, NMNZ M.131536; 6, NZOI P1136), from type locality, 25 October 1979, R/V *Tangaroa* (S147), collected alive. Paratypes (10): SE of Cape Campbell, 42°00.8'S, 174°41.0'E, 939–1019 m, 14 January 1979, R/V *Tangaroa* (1, M.60436); NE of Mernoo Bank, W Chatham Rise, 42°38.2'S, 176°10.5'E, collected alive, 999–984 m, 11 January 1979, R/V *Tangaroa* (2, M.59727); SE Banks Peninsula, 44°46.67'S, 174°91.33'E, collected alive, 692m, 5 October 1979, R/V *Tangaroa* (2, NZOI S143/P1134); SE Banks Peninsula, 44°59.00'S, 174°82.67'E, collected alive, 785m, 4 October 1979, R/V *Tangaroa* (5, NZOI S138/P1135).

Type locality: SE of Banks Peninsula, 44°30.1'S, 174°18.8'E, 760 m.

Other material examined: Off Auckland Islands, 51°10'S, 166°37'E, 490–510 m, 31 October 1994, F.V. *Petersen*, coll. M. Marinovich, found alive amongst sample of cirrate octopods from bottom trawl (1, M.131554).

Distribution (Figure 91): Off western Chatham Rise, 692–1019 m, and off Auckland Islands, 490–510 m; collected alive at 490–999 m from foraminiferal mud.

Remarks: Compared with *Zetela variabilis*, which it most closely resembles, *Z. tangaroa* differs principally by having a larger protoconch, weaker axial sculpture, and in lacking a basal angulation.

Etymology: Named after R/V *Tangaroa*.

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